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The Mecoptera of Indonesia: Genus *Neopanorpa*

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The Mecoptera of Indonesia: Genus *Neopanorpa*¹

ABSTRACT

The Mecoptera (scorpion flies) of Indonesia are limited to species of the genera *Leptopanorpa* and *Neopanorpa* of the family Panorpidae. Our detailed examination of all available museum specimens of Indonesian *Neopanorpa* indicates they form four groups: A *Neopanorpa muelleri* group, including *N. muelleri*, *N. hyalinata*, *N. fuscicauda* n. sp., and *N. umbonata* n. sp.; a *Neopanorpa angustiapicula* group, including *N. angustiapicula* n. sp., and *N. diloba* n. sp.; a *Neopanorpa fractura* group, including *N. fractura* n. sp., *N. crinita* n. sp. and *N. sumatrana* n. sp.; a *Neopanorpa borneensis* group, including *N. borneensis*, *N. flavicauda* and *N. spicata*. One other species, *Neopanorpa lieftincki* n. sp., cannot be placed with any of the groups. Established species are redescribed and new species described. The genera *Neopanorpa* and *Leptopanorpa* are compared and distinguished.

INTRODUCTION

Indonesian insects of the order Mecoptera, commonly known as scorpion-flies, have been studied by van der Weele (1909) and Lieftinck (1936), and incidentally by a few others. Mecoptera of some other areas of southeastern Asia have also been examined in detail: Japan (Miyake, 1913; Issiki, 1933), China (Cheng, 1957), and Indo-China (Byers, 1965).

The Mecoptera are represented in Indonesia only by the family Panorpidae and by only two of its three genera, *Leptopanorpa* and *Neopanorpa*. Weele's work concerned only three forms of *Neopanorpa* (which we think are all of a single species) and four species now assigned to *Leptopanorpa*. Lieftinck later dealt in detail with *Leptopanorpa* only. The primary objectives of this study are to describe the Indonesian species of *Neopanorpa* and to attempt to show how they are related to one another and to the mainland species of the genus. Another purpose is to evaluate the characters used to differentiate *Neopanorpa* and *Leptopanorpa* to determine whether these nominal genera are distinct.

Weele (1909) first proposed *Neopanorpa* as a subgenus of *Panorpa*. Westwood (1842) described its type species, *Panorpa angustipennis*, from either Java or Tenasserim (peninsular Burma), not explaining why he was uncertain of the locality. The female holotype is labeled, "Java." In revising *Panorpa* (1846), Westwood reversed the order of possible type localities as "Tenasserim, India. *vel* Java." Others, however, have regarded *angustipennis* as a Javanese species (Weele, 1909; Enderlein, 1912; Esben-Petersen, 1913; Roepke, 1916), but the Javanese species they described was actually *Neopanorpa muelleri*, as Banks (1931a) supposed. Byers (1965) judged that *angustipennis* is an Indo-Chinese (mainland) species, rather than Indonesian. He showed that the thoracic markings and the genital plates of the holotype of *angustipennis* are characteristic of mainland species, and the wing markings, while very similar to those of *muelleri*, are also like those of some other Indo-Chinese species. He also found that one of two female Malayan specimens matched the type, and judged that those and associated males were conspecific with the holotype.

Weele (1909) separated the Indonesian

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Mecoptera into two genera, *Panorpa* Linnaeus and *Leptopanorpa* MacLachlan. Because he assigned to the genus *Leptopanorpa* those males with length of the abdomen about twice that of the wings, he placed in *Panorpa* four species currently considered as *Leptopanorpa*. Weele differentiated subgenus *Neopanorpa* from typical *Panorpa* because the notal organ of males of the Indonesian species is conspicuous, whereas that structure is but slightly developed in the European species of *Panorpa* with which he was familiar. He also separated from *Panorpa* (*Neopanorpa*) *muelleri* a new, smaller subspecies, *ungaranensis*, that has the pterostigmal band divided into two spots in the hind wings. Karny (1923) said that those characters had no taxonomic significance and he could not tell typical *muelleri* and *m. ungaranensis* apart, for some smaller individuals do not have the pterostigmal band of the hind wing broken into two spots and some larger ones do.

Enderlein (1910) erected the genus *Campodotecnum* for *Panorpa angustipennis* Westwood and the genus *Himanturella* for *Leptopanorpa tubifera* Enderlein and *L. nematogaster* MacLachlan. In 1912, he retained *angustipennis* (actually *muelleri*) in *Campodotecnum* and described two new species, *Campodotecnum lemniscatum* and *C. cingulatum*. He raised *Neopanorpa* to generic status, but designated as its type species *Panorpa nematogaster* MacLachlan (now in *Leptopanorpa*), not knowing that the type species, *angustipennis*, had been fixed by Weele. These errors were noted by Esben-Petersen (1913) and Roepke (1916).

Esben-Petersen (1913) described a new species, *hyalinata*, from Java and transferred *Panorpa jacobsoni* Weele, *P. javanica* Westwood and *P. pi* Weele to the genus *Leptopanorpa*. He also synonymized *Campodotecnum* with *Neopanorpa*, and *Himanturella* with *Leptopanorpa*.

Navás (1913) accepted *Campodotecnum* as the generic name for his new species *falcatum* from Java and added to that genus the species *effusum* Navás, from Sikkim.

In 1915 Esben-Petersen transferred *Panorpa nematogaster* MacLachlan and *Neopanorpa linguata* Navás to the genus *Leptopanorpa*, both as synonyms of *Leptopanorpa charpentieri* Burmeister. Later, in 1921, he reviewed the Javanese species of *Neopanorpa*, including as valid species *angustipennis* Westwood, *hyalinata* Esben-Petersen, *muelleri* Weele, *lemniscata* Enderlein and *cingulata* Enderlein. He synonymized *Campodotecnum falcatum* Navás with *hyalinata* and *muelleri ungaranensis* with *muelleri*. Variation, especially of color, in the latter pair was earlier discussed by Roepke (1916), who presumed that they were the same species.

Banks (1931b) described *Neopanorpa flavicauda*, the first mecopteran recorded from Borneo, and suggested (1931a) for the first time, that Weele's *angustipennis* is only a form of *muelleri*.

Lieftinck (1936) accepted the new status of some *Leptopanorpa* species transferred from *Panorpa* by Esben-Petersen (1913) and described six new species as *L. erythrura*, *L. filicauda*, *L. inconspicua*, *L. peterseni*, *L. robusta*, and *L. sarangana*, and one new subspecies, *L. pi decorata*, adding some morphological and biological observations. He judged that *Leptopanorpa charpentieri*, regarded by Esben-Petersen (1915) as synonymous with *L. nematogaster* MacLachlan, was from Bengal, not from Java. Burmeister, 1839, had said that he would describe a new species from Bengal, but in his description of *charpentieri*, supposedly that new species, he gave the locality as "Ostindien." Since *charpentieri* was unknown to Lieftinck, he thought it was distinct from *nematogaster*. He also suggested that *Campodotecnum lemniscatum* Enderlein was a *Neopanorpa* and

that *C. cingulatum* Enderlein might be identical with his *L. erythrura*. The former is a synonym of *Leptopanorpa pi* Weele and the latter, the senior synonym of *L. erythrura* (Byers, 1967).

Lieftinck made the following statement about synonymy of *Leptopanorpa* and *Neopanorpa*:

"Enderlein, in the Zool. Anzeiger, 35, 1910, p. 192, has erected the generic name *Himanturella*, with *tubifera* Enderlein as genotype, but since *tubifera* End. 1910 is the same species as *longicauda* Weele 1909, which is a true *Leptopanorpa*, Enderlein's unfortunate selection is invalidated. Moreover, Enderlein created a second invalid name in making *Panorpa javanica* Westwood the type of his new genus *Campodotecnum*, a species belonging undoubtedly to *Leptopanorpa*. In 1912, Enderlein adds further to the confusion in placing his *Himanturella* as a synonym of *Neopanorpa*, while *nematogaster* is erroneously fixed as the type of *Himanturella* End. Thus, as has been clearly ascertained by Esben-Petersen in his 'Synonymic List of the order Mecoptera' (Entom. Meddelelser, 10, 1915), *Neopanorpa* Weele 1909 (type: *P. angustipennis* Westwood) is of earlier date than *Campodotecnum* Enderlein 1910, and should be used as the name of this genus, while *Himanturella* becomes an absolute synonym of *Leptopanorpa* MacLachan 1875, of which *ritsemae* is the type."

Byers (1966) described two additional species of *Neopanorpa* from Borneo and redescribed *N. flavicauda* Banks.

The only key for Indonesian *Neopanorpa* (Weele, 1909) concerned primarily those species now assigned to *Leptopanorpa*.

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METHODS AND MATERIALS

We examined 395 dried, pinned specimens, nearly all from the Rijksmuseum van Natuurlijke Historie, Leiden. Most type specimens of older species were examined and drawn (by camera lucida) by Byers in 1964. The lectotypes of *muelleri* and *ungaranensis* were reexamined in 1972 and that of *muelleri* dissected.

Terminology for wing venation is that of Comstock and Needham; for wing markings, that of Esben-Petersen (1921); for male and female genitalia, by Byers (1965).

The genital bulb was removed from the male (sometimes also the 7th and 8th abdominal segments), and the 8th and following abdominal segments from the female. These were boiled in water for one or two minutes to soften them and to prevent breakage during dissection. For the male, the ninth sternum (including hypovalves) and ninth tergum were removed together from the genital bulb. For detailed examination of genitalia the aedeagus was excised by cutting along the inner bases of the basistyles. Dissected parts were preserved in glycerin in microvials, these being attached to the individual specimen's pin. For the female, the

terminal segments were boiled, the subgenital plate of the 8th sternum cut off, and the exposed genital plate was removed. These were preserved on an insect mounting point in a drop of polyvinyl alcohol, which is water soluble, so that the dissected parts can be washed off when re-examination is desired.

Line drawings were made with the aid of a camera lucida. For wing photographs, specimens were relaxed for two days before removal of the wings.

Measurements of antennae, wings and body length were made with dividers and a millimeter scale. Body length was measured as the distance from the front of the head to the end of the dististyles for the male, from front of head to tips of cerci for the female. Wing length is the straight-line distance from point of the wing's attachment to its apex. This is adequate, since precise measurements are not significant in taxonomy of Mecoptera and the method gives a general impression of the insects' sizes.

MORPHOLOGY

GENERAL DESCRIPTION:

Adults of *Neopanorpa* (Fig. 1) are medium-sized insects. The body length is about 14 to 19 mm for males and 11 to 16 mm for females, depending on the species. Wing length is about 12 to 14 mm, variable among species.

Head: Elongation of the clypeus, subgenae and certain mouthparts produces the characteristic beak-like rostrum. The compound eyes are large and black; three large, transparent, brown ocelli are close together on a raised triangle. The term "dorsum of head" used here descriptively refers to the top of the head, from the antennal sockets to the post-occipital margin. Chewing mouthparts are at the end of the rostrum. The small labrum is not separated by a distinct suture from the

greatly elongated clypeus. The mandibles cross each other on preserved specimens. The stipites of the maxillae are greatly elongated and the submentum is elongated and membranous. Tips of maxillary and labial palps are usually darkened.

The antennae are long (about 12 mm) and slender, each composed of a thickened scape, a nearly spherical pedicel and a flagellum, slightly tapered from the base to the apex, consisting of 40 to 46 cylindrical segments or flagellomeres (number varies with species and individuals).

Thorax: The wide pronotum bears bristles or hairs along its anterior margin. Below the pronotum are an undivided pleuron and the front coxae. At each side, between the propleuron and the posterior margin of the head, is a large cervical sclerite. The mesonotum is clearly divided into scutum, scutellum and postnotum, the first two separated by the scutoscutellar suture, and the scutellum from the postnotum by a membranous, intersegmental conjunctiva. The pleural suture is distinct, dividing the pleuron into episternum and epimeron. The metathorax is about the same size and form as the mesothorax. The mesothoracic spiracle is in a membranous area between the pronotum and mesepisternum, and the metathoracic spiracle is between the mesepimeron and metepisternum.

Legs: The coxae and mera are well developed, especially on the mesothorax and metathorax. The femora and tibiae are long and each is of rather uniform diameter throughout. At the apex of each tibia are two large, tibial spurs. There are five tarsomeres, basitarsus much longer than the others. The two pretarsal claws bear five pectinations each.

Wings: There are two pairs of long, narrow wings. Wing shape and venation are useful in generic diagnosis. For *Leptopanorpa*, the wing is narrower than for *Neopanorpa*, especially the wing

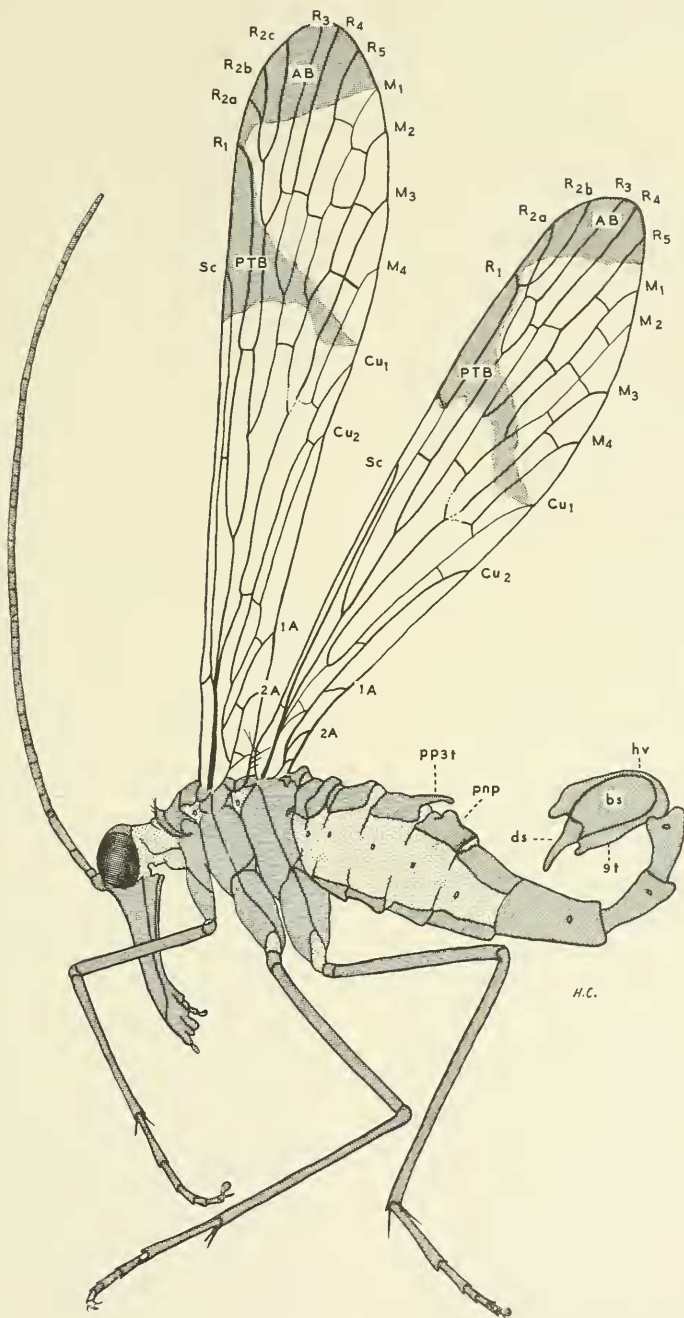


FIG. 1. *Neopanorpa muelleri* (Weele), male, left lateral aspect; wings elevated to show venation; right legs and most of antennal flagella omitted. Abbreviations: A—anal veins; AB—apical band; bs—basistyle, Cu—cubitus; ds—dististyle; hv—hypovalve (abdominal sternum 9); M—media; pnp—posterior notal process; pp3t—posterior process of abdominal tergum 3; PTB—pterostigmal band; R—radius; Sc—subcosta; 9t—abdominal tergum 9.

base. *Neopanorpa* differs from *Panorpa* in the length of vein 1A, which reaches the wing margin before the level of the origin of the radial sector in the former, well beyond it in the latter (Esben-Petersen, 1921). The wing markings (Fig. 1) are smoky dark brown to faint brown, depending on the species. They include: An apical band (AB) extending from anterior to posterior margin at the apex of the wing; a pterostigmal band (PTB), which usually extends from anterior to posterior margin and may or may not fork at mid-length into a proximal (basal) branch and a distal (apical) branch, but which may be reduced to a pterostigma only (*hyalinata*, *angustiapicula*); a marginal spot extending generally from C to near R_{4+5} ; a basal band from C to 1A or Cu_2 , sometimes broken into two spots; and a basal spot near the base of Cu_1 and Cu_2 . The wing markings help in primary identification, varying from the most complete pattern (presence of all the markings, as in typical *muelleri*) to the most reduced, obscure one (*diloba*). They may vary much within one species (*muelleri*); or the same pattern may occur in different species (*umbonata*, *muelleri* and *sumatrana*). The hind wings are usually slightly smaller than the fore wings and have less extensive markings.

Abdomen of the male: There are nine, readily visible abdominal segments. The first tergum is divided into an anterior sclerite joined to the metathorax and a separate posterior sclerite. The median posterior process of tergum 3 (upper part of the notal organ) projects backward from the usually shallowly emarginate tergum and rests on a small elevation on anterior tergum 4. Weele (1909) used this to differentiate *Neopanorpa* as a subgenus from typical *Panorpa*. It varies from species to species, sometimes enough to be used in species diagnosis. The tergum and sternum are fused and the pleura obliterated

in segments 6-8. Paired spiracles are present on the first eight segments.

The enlarged ninth segment (genital bulb) is connected to the eighth by a short pedicel. The ninth tergum (epandrium, or preëpiproct; Fig. 1, 9t) bears two subapical processes that extend ventrally around the tenth segment. In *Neopanorpa*, the apex of tergum 9 has a shape that distinguishes this genus from *Leptopanorpa*, but it does not vary sufficiently within the genus to be useful in species recognition. The ninth sternum (hypandrium) is divided apically into two hypovalves, the length, shape and curvature of which are useful as specific taxonomic characters.

Between the ninth tergum and hypovalves are the stout, paired basistyles (gonocoxites, or coxopodites; Fig. 1, bs). At the apex of each is a chelate dististyle (stylus, or harpagone; Fig. 1, ds), the usually slender, apical half of which is curved mesad and tapers to a sharp point. Projecting from the inner margin of the dististyle near its attachment is the basal lobe (basituberculus of Tjeder, 1970), which varies in size and shape according to the species. For most species, such as *muelleri* or those of the *fractura* group, the basal lobes are knob-like, but for a few (the *angustiapicula* group) they are flattened (Figs. 83, 87). Two to four long, stout, curved, black spines project mesad from the dorsal surface of the basal lobe in the *muelleri* group (Fig. 26), but are absent in other Indonesian species. Smaller, curved, black spines (4 to 25 in number) may also occur in a group on the anterodorsal surface of the basal lobe.

The structure of the aedeagus assists specific diagnosis but has not been used in earlier taxonomic treatments of Indonesian *Neopanorpa*. Most of the aedeagus is only weakly sclerotized, but certain parts are firm and darkly pigmented. The aedeagus (Figs. 17, 27) consists of a pair of blunt

ventral valves (penis) slightly divergent at their apices, a usually somewhat smaller pair of dorsal valves, and associated appendages. It is braced between the basistyles by the lateral processes. These processes are simple for nearly all Indonesian species, but in the *angustiapicula* group they are complexly divided into two lamellae enclosing a deep pocket. Ventral parameres are not present on Indonesian *Neopanorpa* except in the *angustiapicula* group, where they are large, project ventrally from the genital bulb and are partly visible, laterally (Fig. 71). The dorsal parameres (penunci of Tjeder, 1970) are ordinarily small, vertically oriented blades of varying shape, above the dorsal valves of the aedeagus. They are, however, complicated for *fuscicauda* and the *fractura* group, extending ventrally alongside the ventral valves of the former and bearing a small, flattened, dorsal appendage, projecting dorsad, on the latter.

Segments 10 and 11 comprise the procitiger. They are small and ordinarily telescoped beneath tergum 9. The single-segmented cerci arise between segments 10 and 11.

Abdomen of the female: The abdomen of the female of *Neopanorpa* is very similar to that of *Leptopanorpa*. Ten clearly recognizable segments taper gradually to the rear, and paired spiracles are present on the first seven. No laterotergites are present on the seventh and eighth segments as on some *Panorpa*. Part of segment 8 is modified as the subgenital plate, and the tergum and sternum are fused on segment 10. The two-segmented cerci arise from the so-called cercifer (cercal bases, in Ferris, 1939) of the tenth segment.

The eighth and ninth segments include external female genitalia. The subgenital plate (subgenitale) of sternum 8 is broad, usually notched and whitish apically (except in *angustiapicula*), and bears long

setae on each posterior lobe and along the apical, outer margin of some species (Fig. 28). Above the subgenital plate are the so-called genital plates (internal skeleton, in Miyake, 1913; medigynium, in Tjeder, 1970). These provide the best specific characters for the female. Each (Fig. 29) is composed of an axial portion (gonoclavi of Tjeder, 1970) above and behind which are two blade-like arms (distal plate or laminae), twisted somewhat at their bases. The axial portion is usually elongate in Indonesian species, but is short and oval for a few (*fractura* group, *fuscicauda*, *angustiapicula* group and *borneensis* group).

The taxonomic characters used by most authors who have dealt with Indonesian Mecoptera, such as differences of size, of wing markings and body color, and overall shape of the genital bulb in males, are not sufficient for species distinction. For example, Weele (1909) separated a new subspecies, *Neopanorpa muelleri ungaraensis*, from his new species *muelleri* by its smaller size and the division of the pterostigmal wing band into two spots in the hind wing, but he ignored the identical structure of the genitalia of the two forms. Some authors later regarded certain individuals of *muelleri* as Javanese specimens of *N. angustipennis* Westwood because of their general appearance, especially wing pattern; but they ignored the absence of thoracic markings on *muelleri* and its distinctive genitalia. Wing pattern and body color have taxonomic value only when associated with genitalic and other characters. Accurate distinction of species requires comparison of the combination of all available characters.

TOPOGRAPHY, CLIMATE AND VEGETATION

Indonesia now includes Sumatra, Java, Sulawesi (Celebes), Kalimantan (Indonesian Borneo), Nusa Tenggara (the Lesser

Sunda Islands), Maluku (the Moluccas, including Ceram and Halmahera), Flores, Sumbawa, part of Timor, West Irian (approximately the western half of New Guinea) and some 3000 smaller islands. In the past, the name Indonesia was applied to various combinations of these and adjacent territories. Most of these islands belong to young, Tertiary mountain systems that lie completely in the tropics and within the Indo-Australian monsoon region. Indonesia therefore has a climate with high temperatures, high humidity and abundant rains. The mean annual temperature at sea level is about 27° C (80° F) and the mean humidity 80%. The montane climate is more temperate. There is a decrease of temperature between 5.5 and 6° C (10-11°F) for each rise of 1000 m, e.g., the average temperature is 22.1° C (71.8° F) at Bandung, 730 m above sea level, and only 15.9° C (60.8° F) at Tosari, 1734 m in altitude (Bemmelen, 1949).

Since Mecoptera are known only from Sumatra, Java, Borneo and possibly Halmahera, the following geographical comments pertain only to these islands.

Sumatra (Fig. 5), located southwest of the Malay Peninsula, has an area of 435,000 sq. km. It is 1650 km long by 100-200 km wide in the northern part and about 350 km wide in the southern part. It lies between latitude 5°45' N and 6° S and longitude 95°20' E and 106° E. The Barisan Mountains extend along the entire southwestern coast and separate the northeastern and southwestern coastal lowlands. The slope toward the Indian Ocean is generally steep. The eastern and southeastern parts of the island are jungle lowlands traversed by five major rivers. The southwestern coastal range (Barisan Mountains) contains many peaks from 2000 m to 4000 m high, often of volcanic origin, some still active.

With the equator crossing Sumatra near its center, the climate is equatorial.

The average, annual, lowland temperature is about 27° C (80° F); rainfall is heavy. The slopes, exposed to a continual southwestern wind, receive more than 300 cm of rainfall, annually, that is distributed fairly evenly over the island (Robequain, 1954). The warm, moist air favors growth of dense forests (myrtaceous and ficaceous trees, oaks, guttapercha, camphor, teak, pine, etc.) that cover about 90% of the island.

In the forests, the Sumatran *Neopanorpa* flourish. Hesse (1937) believed endemic animal species of Sumatra were primarily found south of the mountains; but most of the six endemic Sumatran species of *Neopanorpa* are distributed on both the southwestern and northeastern slopes of the mountains. Hesse (1937) also thought faunal differences between the two coastal lowlands of Sumatra exceed the differences between the northeastern slopes and the Malay Peninsula; but, again, this is not the case with the Sumatran species of *Neopanorpa*. The species of Sumatra have not been found in nearby Malaya.

Java (Figs. 2-4), located southeast of Sumatra and south of Borneo, between the Java Sea and the Indian Ocean, has an area of 127,000 sq. km. It is 975 km long by 206 km wide at its widest part and lies between 5°52' and 8°47' S and 105°13' and 114°37' E. Three physiographic provinces can be distinguished: 1. West Java (west of the longitude of Tjeribon) (Fig. 2). 2. Central Java (between Tjeribon and Semarang) (Fig. 3). 3. East Java (east of Semarang and Jogjakarta) (Fig. 4).

The west-to-east mountain chain includes 112 major volcanoes, 35 still active. The northern coast is lowland, of volcanic deposits or marine sand and clay, but the southern coast has limestone ridges. In East Java, the mountains are generally near the southern coast. These include Java's highest volcanic peak, Mahameru

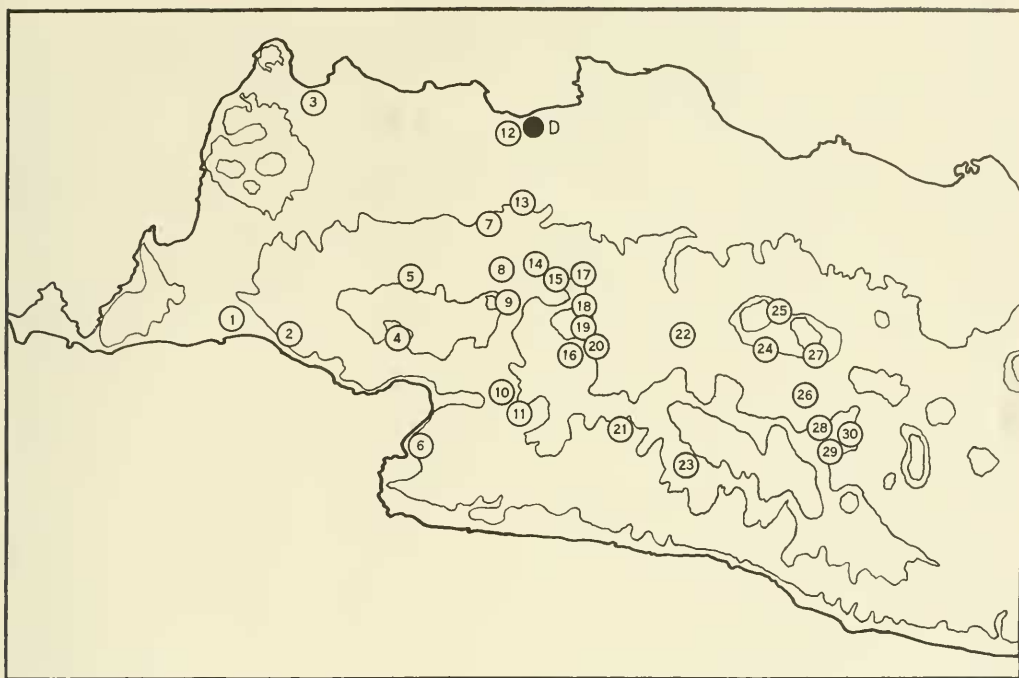


FIG. 2. MAP OF WESTERN JAVA. Circles indicate localities where Mecoptera have been collected. Numbers, in sequence from left to right, correspond to locality numbers appearing in the alphabetical gazetteer. Black spots indicate major cities; D—Djakarta. Contour lines at 100 m, 1000 m, and 2000 m, to indicate coastal lowlands, intermediate elevations, and high mountains.

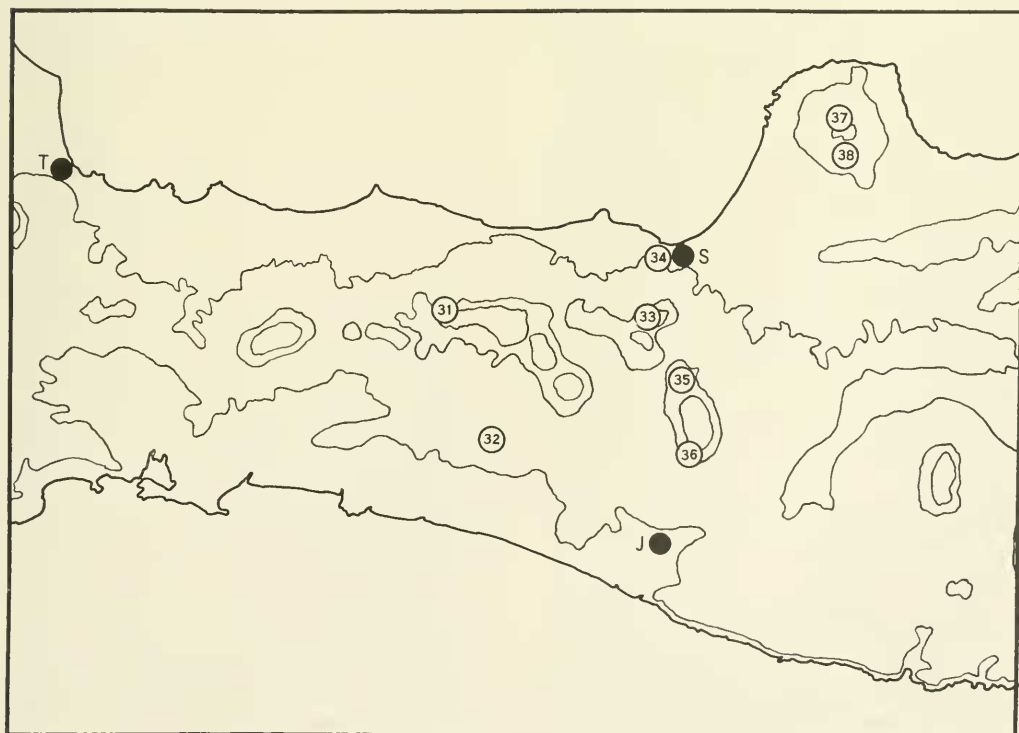


FIG. 3. MAP OF CENTRAL JAVA. See Fig. 2 for explanation. J—Jogjakarta, S—Semarang, T—Tjeterbon.

(3711 m; 12,060 ft), and the volcanic Tengger, Ijang and Ijen highlands, which form a wide peninsula extending eastward toward Bali. In Central Java, the mountains are more central and the main watershed is toward the south. Here, the volcano Slamet reaches 3472 m. The Preanger Mountains in southeastern West Java are lower (the major peak less than 3000 m) and include extensive upland basins. Further westward the summits are lower, but rise again in the northwest to nearly 2000 m. There are four major rivers, draining generally northward.

The coastal temperature of Java averages 26-27° C (78-80° F), while temperate conditions occur above about 700 m. In general, humidity is high (75%-90%). The Asiatic (northwest) monsoon, from November to April, brings much rain, especially in the north. From May to October, the southeast monsoon season brings some rain to the southern coast but in general is drier than the northwest monsoon. Western Java (except northwest Java) and the entire southern coast have high annual rainfall (more than 200 cm), quantity depending largely on the altitude and situation of the mountains. Bogor (Buitenzorg), 290 m above sea level, has more than 406 cm of rain per year; Bandung, at 730 m, 195 cm. Maximal rain falls in the Djampang, on Mt. Tangkuban Prah, Mt. Malabar, various mountains of East Priangan, and Mt. Tjerimai (Tjaréme) in Tjeribon. In Central Java, annual rainfall is 665 cm on the upper northern slopes of the mountains, but only 215 cm at Semarang on the northern coast. The rainfall is not so evenly distributed as in West Java. There is an obvious dry season from June to September. Semarang receives only 13% of its total rainfall during the four-month dry season. In Central Java, the maxima of rainfall are found on Mt. Slamet and the range east of it, including Mt. Ungaran, the Merbabu and Merapi

volcanoes. East Java is drier than Central Java. The foehn-like, southeastern, moonsoon winds from the Australian deserts are generally warm and relatively dry. They bring less rainfall to the eastern end of the island than to the central part, eastern volcanic peaks becoming islands of heavier rainfall. The northeastern coastal lowlands get only 150-200 cm of rain, annually, the months of July to October being practically dry (Bemmelen, 1949). In East Java, regions of maximal rainfall are on Mt. Lawu, the Tengger Mountains, the southern slopes of Mt. Raung and Idjen Plateau.

Rainfall decreases from western Java to eastern Java, and because the southern mountain slopes force the monsoon winds to rise, there is also a decrease from south to north. This pattern of rainfall coincides with the distribution of Javanese *Neopanorpa* (Figs. 2-4), just as it does with that of *Leptopanorpa* (Lieftinck, 1936). The genus *Neopanorpa* requires high atmospheric humidity. The distribution and mode of life of Indonesian scorpion flies are closely related both to the total amount of rain and the seasonal rainfall pattern.

Java's many volcanoes and its heavy equatorial rainfall contribute to the fertility of the soil and the abundant plant and animal life. The moist mountain slopes have an extensive evergreen forest with the tall timber tree, *rasamala*, common in the west, but absent in the east where mountain *Casuarina* is plentiful. Teak is more frequent and the evergreen rain forest less robust in Central Java than in West Java. Many species of scorpion flies are apparently restricted to the luxuriant forest in the mountains of western Java. Mayr (1944) called the fauna of Java impoverished, compared to that of Sumatra (or Borneo). However, collections of scorpion flies suggest the opposite. Mayr thought the volcanic lava and ashes during the Pleistocene may have exterminated

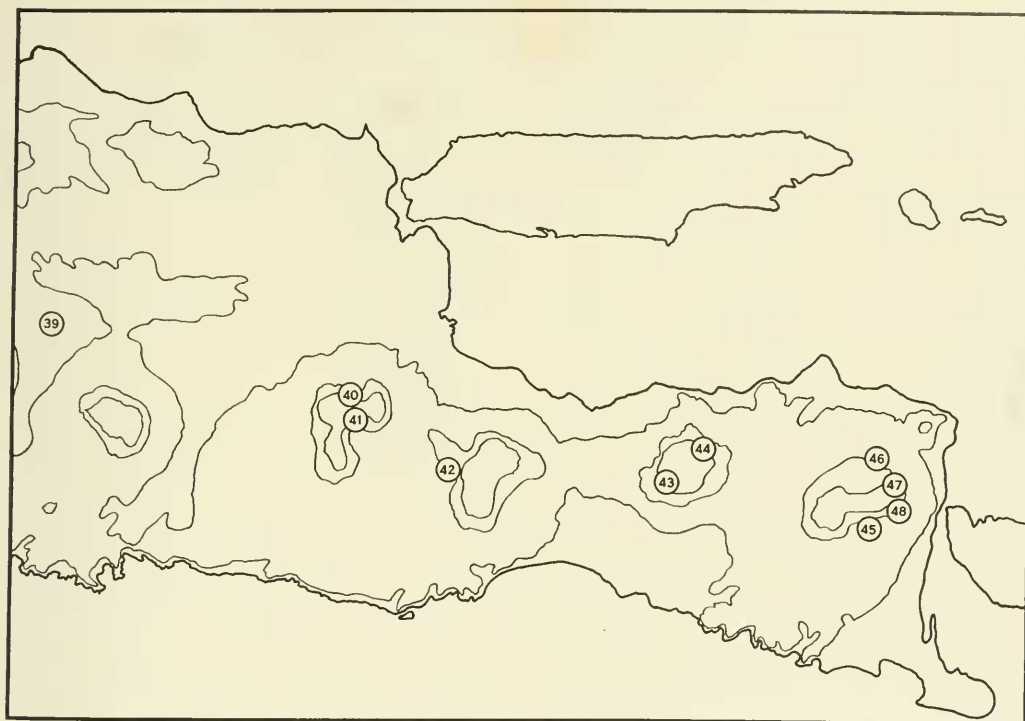


FIG. 4. MAP OF EASTERN JAVA. See Fig. 2 for explanation.

many local species and that Java is less humid and poorer in habitats than Sumatra, more peripheral and less accessible to colonizing species. We suggest that human depletion of forests in Java (20-30% of the surface covered with forests, as contrasted with 90% in Sumatra), destroying much of the shaded habitat of scorpion flies, must have had a profound effect upon the present fauna.

Borneo, the second largest island of the Malay Archipelago (736,000 sq. km), is roughly triangular, with two small peninsulas at its eastern side, and lies between latitude $7^{\circ}3' N$ and $4^{\circ}20' S$ and longitude $108^{\circ}50' E$ and $119^{\circ}20' E$. Its northern and central parts are hilly and mountainous, but mostly under 1500 m. The chief ranges extend northeast to southwest, with western, southwestern and eastern branches. The highest point is Mt. Kinabalu, 4485 m (13,456 ft), in Sabah, the northernmost part of the island. Alluvial plains between

ranges are often swampy near the ocean because of tidal flows. Most of Borneo has evergreen rain forest of rich and varied vegetation. Coastal temperatures usually range from $28-34^{\circ} C$ ($82-93^{\circ} F$). The rainfall is often violent; mean, annual rainfall is about 310 cm at Sandakan. The few records of Mecoptera from Borneo are from highlands around Mt. Kinabalu.

Since Panorpididae usually frequent moist, northern, continental, temperate forests, their penetration into Indonesian tropics requires explanation. Perhaps panorpids migrated there from the Asiatic mainland when Indonesia was much cooler than now. As the climate warmed, the panorpids moved to suitably cool and forested habitats on mountain slopes, where they survive today.

Some of the species appear to us to have narrow vertical limits. *N. angustipicula* is found only above 2000 m; *N. lieftincki* at approximately 1900 m; *N.*

fractura at 1400 m; *N. diloba* and *N. fuscicauda* around 1000 m; *N. sumatrana* between 920 and 1200 m; *N. crinita* between 500 and 1000 m. Those species having narrow vertical limits are also often limited to one area only: *N. angustipicula*, *N. diloba* and *N. fuscicauda* have been found only in East Java; *N. lieftincki* and the *fractura* group in Sumatra only. Some other species have a much broader vertical distribution: *N. muelleri* can be found from low country (at 100 m, 500 m and 1000 m) to above 2000 m altitude; *N. umbonata* ranges from the coast to 920 m; and *N. hyalinata* is found from 300 to 1850 m. Other species tend to have wider horizontal or overlapping distributions: *N. muelleri* occurs throughout the islands of Java and Sumatra; *N. hyalinata* occurs both in West Java and East Java but as yet is unknown in Central Java. *N. muelleri* is the only species known from both Java and Sumatra (and possibly Halmahera). *N. muelleri* might have developed before these two islands became separated.

The doubtful record of *N. muelleri* from Halmahera is discussed elsewhere in this paper (see Zoogeography).

ZOOGEOGRAPHY

Neopanorpa occurs only in southeastern Asia, where 83 species (including 8 new species from Indonesia) are known. Thirty are in nine provinces of southern and southeastern China, including Sikang, Szechwan, Yunnan, Kweichow, Anhwei, Kiangsu, Kiangsi, Fukien, Kwangtung (Cheng, 1957); 17 are found in southern India, southern Nepal, Sikkim, Assam and Burma (Rust and Byers, 1976); 14, in Indo-China (Byers, 1965); 9, in Taiwan and 13 (including the 8 new species) in Indonesia. There appears to be no overlap of specific ranges from one of these regions to another. This may be due to restricted ranges, but more probably to insufficient collecting.

The 13 Indonesian species of *Neopanorpa* are restricted to Java, Sumatra, and Borneo (and perhaps Halmahera); one occurs in Java and Sumatra (possibly also Halmahera), 4 others on Java, 5 others only on Sumatra and 3 others only on Borneo. There is as yet no record of Mecoptera from Celebes, Lesser Sunda Islands (Lombok, Sumbawa, Flores, Timor, etc.) or New Guinea. Lack of records of *Neopanorpa* and other Mecoptera from these islands may be due to inadequate collection or to physical barriers, or both.

In early Miocene or late Oligocene, the earth's crust buckled downward along the western Sumatran islands (Simeulue, Nias, Kepulauan, Batu, Siberut, Sipura, etc.), Timor, Kai, Ceram and Halmahera (Earle, 1845, in Mayr, 1944). In late Miocene, a second folding formed parts of Sumatra and Java. At first most of this fold was under water, some islands not emerging until mid-Pleistocene. The Pleistocene ice-age lowered the sea level to about 100 m lower than now, establishing several land connections between present islands (map, pp. 16, 17, Townes and Chiu, 1970). Sumatra, Java, Bali and Borneo and the Malay Peninsula formed "Sundaland," an extension of the Asiatic mainland. Lombok, however, remained separated by the 312 m depth of Lombok Strait (Mayr, 1944). We presume that Mecoptera from mainland Asia migrated across these land connections to Sumatra, Java, Borneo and the Philippines during the cool Pleistocene.

The Indonesian Mecoptera (all in the family Panorpidae) have no taxonomic familial connections with Mecoptera of Australia (families Bittacidae, Choristidae, Nannochoristidae, Apteropanorpidae and Meropeidae). Instead, the Mecoptera of Australia show connection with those of South America, e.g., the genus *Nannochorista*, occurring also in Chile and Argentina (Riek, 1954). Many elements in

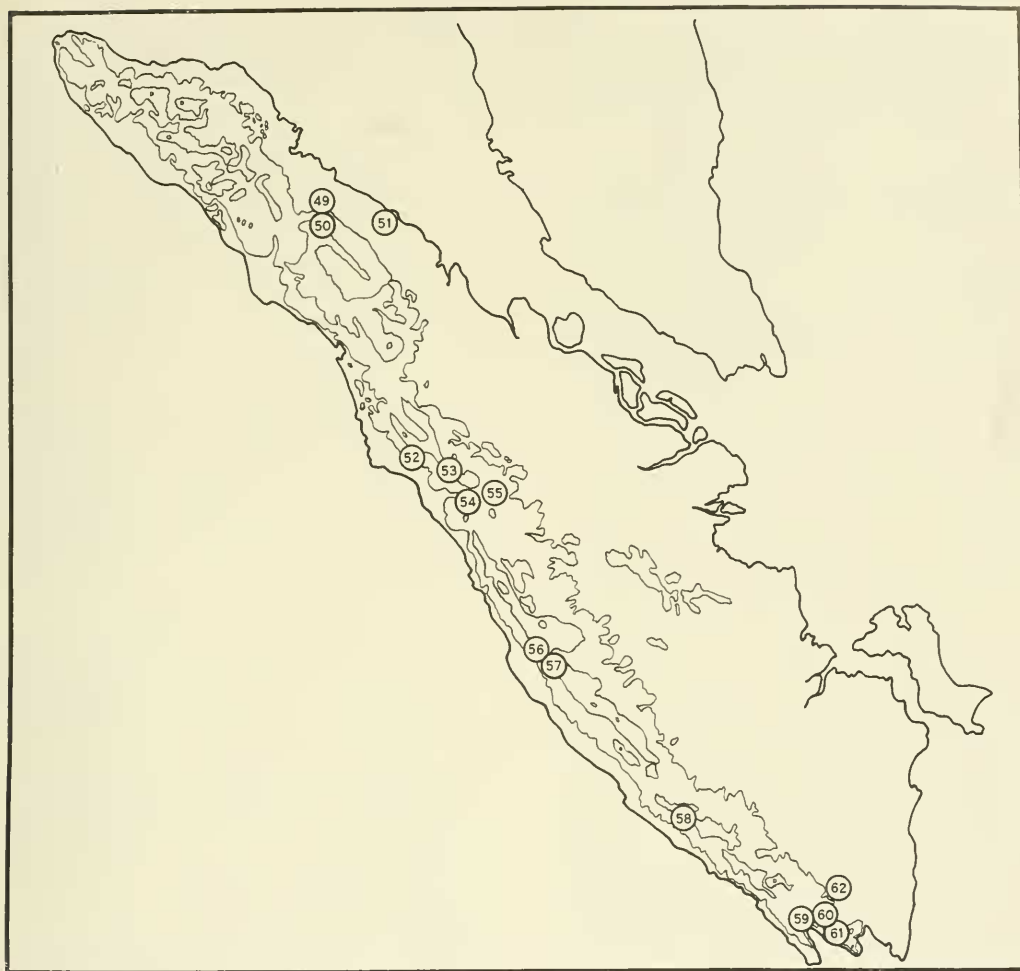


FIG. 5. MAP OF SUMATRA. See Fig. 2 for explanation of symbols. Contour lines at 200 m, 1000 m, and 3000 m, to indicate coastal lowlands, intermediate elevations, and high mountains.

other groups of insects (Edmunds, 1957, and Hardy, 1951, in Gressitt, 1958), in vertebrates and plants are common to Australia, southern South America and, in some cases, Africa (Gressitt, 1958). This tends to support the existence of an original southern supercontinent ("Gondwanaland") which may have existed some 150 million years ago, of which an Australian fragment broke off and moved northward, joining Asia. Geological changes (sea level, orogenic forces, coral formation, etc.), later broke the connection between Asia and Australia, re-established it and broke it again (Robequain, 1954).

Animals and plants originating in Asia developed, in Australia, as unique life forms, due to the long period of isolation.

As pointed out by Liefstinck (1936), all the Indonesian Mecoptera are endemic; even the species of Sumatra are not known from nearby Malaya. Of the two Indonesian genera, *Neopanorpa* and *Leptopanorpa*, only the former occurs on mainland Asia. *Leptopanorpa*, as we have limited the genus, is known only from Java, but possibly occurs on Sumatra as well. We have examined the syntypes (1 male now without abdomen and 1 female) of *L. charpentieri* (Burmeister), described

from "Ostindien." They bear no locality labels. Lieftinck, in 1936, assumed the species was from Bengal as indicated in the Introduction above. Esben-Petersen (1921) correctly synonymized *charpentieri* and *nematogaster*; Lieftinck did not agree. We believe that *nematogaster* is a synonym of *charpentieri*, and we conclude that *L. charpentieri* is from Indonesia, not from India. The other two supposed Himalayan Leptanorpas, *L. furcata* and *L. effusa*, are large *Neopanorpa* species (Byers, 1971).

Endemicity of Indonesian Mecoptera is probably due to evolution in the present ranges following migration of ancestral species from mainland Asia. These migrants were isolated by water barriers resulting from the melting of the glaciers during and at the end of the Pleistocene.

Warming lowland temperatures probably further isolated these Mecoptera, driving them up into their somewhat isolated ranges on mountains. Mecoptera are not strong fliers; their low vagility intensifies spatial isolation, inbreeding and species formation, giving rise to endemic species or even endemic genera in the particular environments of the isolated tropical islands. We now find no species common to Malaya and Sumatra, and only one, *N. muelleri*, occurring both on Java and Sumatra.

Two specimens of *N. muelleri* in the Canadian National Collection are labeled as from Halmahera. How did these Java-Sumatran species cross approximately 1450 km (900 mi) from Java to Halmahera? Perhaps the specimens are mislabeled. Townes and Chiu (1970: 234) doubted the supposed occurrence of the ichneumonid wasp, *Xanthopimpla f. fastigiata*, on Halmahera, the specimens thereof in question having been collected by the same collector whose label appears on the supposed Halmahera *N. muelleri*. Wallace's Line may

hold its validity for such weakly flying insects as Mecoptera, if the labels are correct, for both flying and flightless Indo-Malayan elements have been found even in Timor (Rensch, 1936, in Mayr, 1944); and the straits separating the Indonesian islands have not been absolutely insuperable obstacles to the migration of animal and plant species (Robequain, 1954). Mayr (1944) states that each of the straits in the Lesser Sunda Islands is to some extent a zoogeographic barrier, with the Lombok Strait more effective than any of the others, because of its depth and its persistence through periods of low sea level during the Pleistocene.

TAXONOMY

We divide the Indonesian Mecoptera into four groups, as follows, primarily on the basis of genitalial structure of the males and to a lesser degree on the basis of genitalial characters of the female and wing pattern. One species (*lieftincki*, n. sp.) must be placed alone.

Neopanorpa muelleri group:

muelleri van der Weele
hyalinata Esben-Petersen
fuscicauda, new species
umbonata, new species

Neopanorpa angustipicula group:

angustipicula, new species
diloba, new species

Neopanorpa fractura group:

fractura, new species
crinita, new species
sumatrana, new species

Neopanorpa borneensis group:

borneensis Byers
flavicauda Banks
spicata Byers

Ungrouped species:

lieftincki, new species

KEY TO MALES OF *NEOPANORPA*
IN INDONESIA

This key is based mainly on readily visible characters, not requiring dissection for visibility. Identifications may be verified by reference to structural details of genital bulb, etc., in the species descriptions.

1. Hypovalves of sternum 9 each bearing a lightly sclerotized projection from dorsal surface near mid-length (seen in lateral aspect) 2
 Hypovalves of sternum 9 without such projections 6
2. Hypovalves expanded basally and attenuate toward apex 3
 Hypovalves not expanded basally or not attenuate toward apex 4
3. Basal lobe of dististyle conspicuously divided into a proximal and a slightly larger distal protuberance (fig. 134) *flavicauda*
 Basal lobe of dististyle divided into a ventral portion and a more thickened dorsal portion (fig. 127) *borneensis*
4. Dorsal surface of hypovalves bearing long hairs (fig. 104) *crinita*
 Dorsal surface of hypovalves without long hairs 5
5. Apical band and pterostigmal band entire; dorsal sclerotized projections of hypovalves small, forming about a 25° angle with hypovalves (fig. 114) *sumatrana*
 Apical band almost absent, or reduced to spots; pterostigmal band much constricted near mid-length; dorsal sclerotized projections of hypovalves expanded, forming about a 35° angle with hypovalves (fig. 93) *fractura*
6. Hypovalves acuminate in apical half or abruptly narrowed in apical one-third 7
 Hypovalves gradually narrowed, rounded at apex 8
7. Posterior process of abdominal tergum 3 extending across about two-thirds length of tergum 4; hypovalves overlapped mesally near mid-length (fig. 67); pterostigmal band much reduced, with only conspicuous stigma remaining (fig. 66); general body color reddish brown; occurring in Java *angustiapicula*
 Posterior process of abdominal tergum 3 long, extending to mid-length of segment 6 (fig. 138); hypovalves separated throughout their length (fig. 139); pterostigmal band complete; general body color dark brown to brownish black; occurring in Borneo *spicata*
8. Wing markings almost obliterated, very faint smoky brown; basal lobe of dististyle without stout, black dorsal spines 9
 Wing markings conspicuous, dark smoky brown, even if only pterostigma remains; basal lobe of dististyle bearing stout, black dorsal spines (fig. 26) 10
9. Outer edges of hypovalves greatly infolded, the folded margins subparallel in ventral aspect (fig. 142); basal lobe of dististyle concave mesally, not flattened (fig. 145) *lieftincki*
 Outer edges of hypovalves slightly infolded, the folded margins not subparallel in ventral aspect (fig. 81); basal lobe of dististyle flattened, divided into ventral and dorsal parts (figs. 83, 87) *diloba*
10. Wings almost clear, hyaline, with only conspicuous pterostigma darkened (figs. 30-32) *hyalinata*
 Wing markings more complete, usually including apical and pterostigmal bands 11
11. Ventral and dorsal portions of basal lobe of dististyle distinctly separated, ventral portion flattened, rounded, directed ventrocaudad, not concealed by hypovalves (fig. 56); dorsal sur-

face of dorsal portion of lobe bearing three sizes of spines in three proximate groups (fig. 62) *umbonata*

Ventral and dorsal portions of basal lobe of dististyle either not clearly separated or not far apart, both usually concealed by tips of hypovalves, directed mesad; dorsal surface of lobe bearing two sizes of spines in two separated groups 12

12. Genital bulb uniformly dark brown to blackish brown; basal lobe of dististyle about as wide as long (fig. 47) *fuscicauda*

Genital bulb mostly yellowish brown to brown (brown throughout in a few individuals); basal lobe of dististyle much less wide than long (figs. 25, 26) *muelleri*

KEY TO FEMALES OF *NEOPANORPA* IN INDONESIA

Specific identification of females usually requires examination of the subgenital plate and the genital plate, the latter visible by simple dissection described earlier. The female of *diloba* is unknown; that of *flavicauda* has not been examined in detail.

1. Wing markings much reduced or nearly obliterated; markings may be only faint brown, or apical band may be reduced to a few spots, pterostigmal band either entire or interrupted near mid-length; or wings may be almost clear and hyaline, with only pterostigma remaining 2
Wing markings dark smoky brown, usually including entire apical band and pterostigmal band (includes *flavicauda* and probably *diloba*) 6
2. Pterostigmal band reduced to pterostigma only, or with only a small triangular extension behind stigma .. 3
Pterostigmal band faintly indicated, or entire or interrupted near mid-length 4

3. General body color reddish brown; apical band usually present but not entire; axial portion of genital plate ovoid (figs. 66, 77) *angustiapicula*

General body color dark brown to blackish brown; apical band absent, wings almost clear-hyaline except for conspicuously darkened stigma; axial portion of genital plate forked anteriorly (figs. 30, 43) *hyalinata*

4. Wing markings faint brown, much reduced and almost obliterated; axial portion of genital plate forked anteriorly, without lateral lobes (figs. 141, 150) *lieftincki*

Wing markings dark smoky brown, distinct; apical band reduced to spots, pterostigmal band either entire or interrupted near mid-length; axial portion of genital plate ovoid with rounded lateral lobes 5

5. Pterostigmal band entire, with conspicuous proximal branch, distal branch obliterated or represented by a spot; subgenital plate narrowed smoothly to apex; lateral lobes of genital plate conspicuous, darkly sclerotized (figs. 101, 110) *crinita*

Pterostigmal band interrupted or greatly constricted near mid-length, proximal branch usually reduced to a spot; subgenital plate narrowed abruptly near mid-length; lateral lobes of genital plate inconspicuous, visible only by transmitted light (figs. 89, 99) *fractura*

6. Axial portion of genital plate forked anteriorly 7

Axial portion of genital plate not forked anteriorly 8

7. Tips of anterior branches (apodemes) of axial portion of genital plate thick, bent sharply laterad (fig. 64) *umbonata*

Tips of anterior branches of axial portion of genital plate slightly thickened, not bent (fig. 29) *muelleri*

8. Axial portion of genital plate short, conical; bases of arms of plate expanded to form a darkly sclerotized, subquadrate plate cleft medially above apex of axial portion (fig. 51) *fuscicauda*
 Axial portion of genital plate short but ovoid; bases of arms of plate not forming a subquadrate plate 9
9. Genital plate without rounded lateral lobes (fig. 140) *spicata*
 Genital plate with rounded lateral lobes 10
10. Subgenital plate narrowed from near mid-length to apex, with pale median streak or zone (fig. 130)
 *borneensis*
 Subgenital plate narrowed in posterior one-third, without pale median zone but with pale area just before apical notch (fig. 120) *sumatrana*

DESCRIPTIONS OF SPECIES

NEOPANORPA MUELLERI Group

Neopanorpa muelleri Weele, 1909

Panorpa mülleri Weele, 1909.

Panorpa mülleri ungaranensis Weele, 1909.

Panorpa angustipennis; Weele, 1909 (misidentification).

Van der Weele based his description of *muelleri* on one male and five females and that of *muelleri ungaranensis* on one male and four females. The male specimen of each of these is hereby designated as respective lectotype.

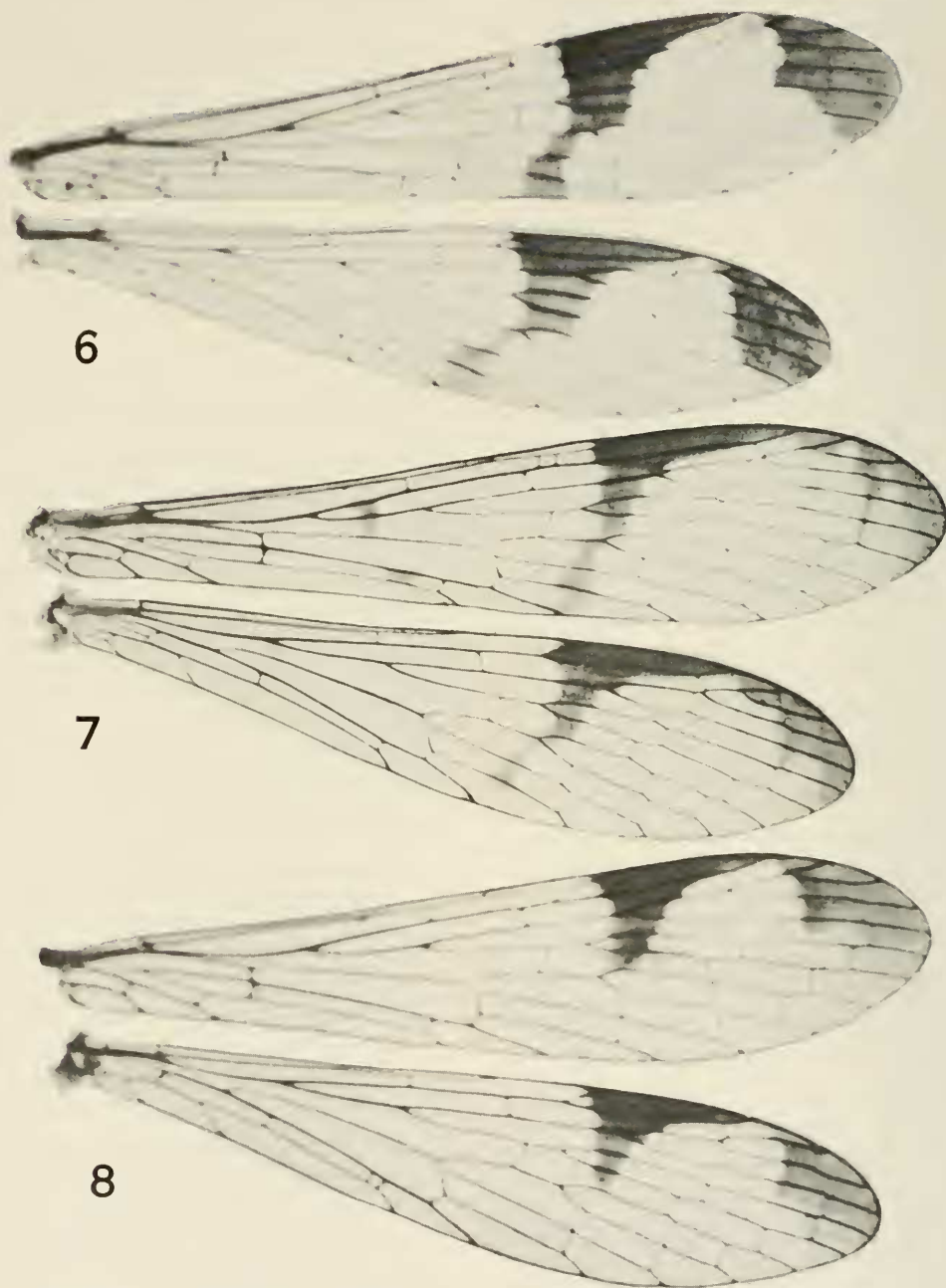
Head: Dorsum glossy blackish brown to black; frons below antennal sockets dark brown to blackish brown; rostrum reddish brown to dark brown anteriorly, yellowish brown to brown laterally or laterobasally; mouthparts reddish brown to dark brown, black on tips of palps in some specimens. Antennal scape yellowish brown (lectotype) to brown, pedicel brown (lectotype) to dark brown; flagellum dull

dark brown basally, remainder dull blackish brown to black; 41 flagellomeres.

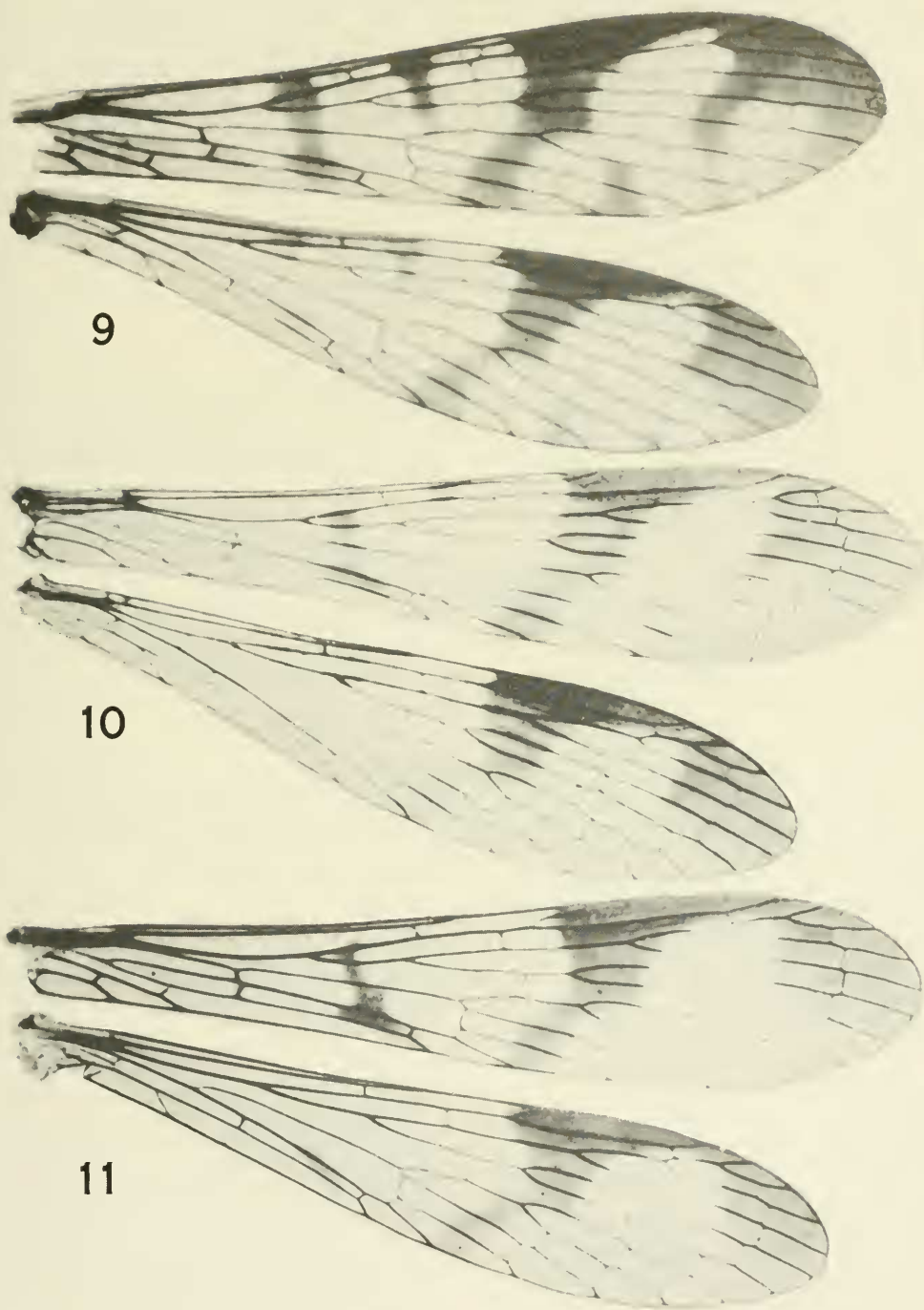
Thorax: Pronotum black, with 2-5 bristles at each side along anterior margin. Mesonotum and metanotum black, with small dark brown areas near wing bases in most specimens; paler on scutellum in some specimens. Pleura and coxae dingy yellowish brown, dark brown near wing bases in a few specimens, to dull dark brown throughout; femora yellowish brown to dark brown; tibiae and tarsi dark brown.

Wings (Figs. 6-14): Almost colorless, slightly iridescent, with smoky dark brown bands and spots. Apical band usually complete, with variously shaped proximal prominence in both fore and hind wings, or reduced to narrow darkened zone along apical margin and one or two other slender spots, usually along crossveins (six specimens). Pterostigmal band usually complete, narrowly joining apical band along costal margin, not forked in most specimens. Marginal spot conspicuous to small or absent. Basal band entire, of variable width, or reduced to one or two spots, or absent. Basal spot present or absent.

Abdomen of male: Terga 1-6 blackish brown to nearly black; sterna 2-5 yellowish brown to dull dark brown; segment 6 paler ventrally than dorsally. Segments 7-8 yellowish brown, reddish brown or dull dark brown. Posterior process of tergum 3 narrowly triangular, extending about half-way across tergum 4. Hypovalves of sternum 9 darkened or not (dark brown at least basally, where they are separated by a nearly circular space, below which is a semicircular, pale membranous area), widened at mid-length, often overlapping, paler and covered with long hairs apically (Fig. 15). Ninth tergum yellowish brown to dark brown, paler and shallowly emarginate apically. Cerci pale at base, dark brown at apex. Basistyles mostly dark



FIGS. 6-8. *Neopanorpa muelleri* (Weele), wings, showing variation in degree of pigmentation. 6, specimen from Central Java; 7, from West Java; 8, from East Java. See also FIGS. 9-14.



FIGS. 9-11. *Neopanorpa muelleri* (Weele), wings, showing variation in degree of pigmentation. 9, specimen from Sumatra; 10, 11, specimens from West Java. See also FIGS. 6-8, 12-14.

brown, lighter brown where concealed by hypovalves. Dististyles darkened basally, paler apically, or of uniform color throughout, outer margin slightly concave near base, abruptly curved near apex. Ventromesal concavity of basal lobes of dististyles medium (lectotype) to large, with pendant mesal and lower margins (Figs. 22, 24); 2-4 large, apically curved, black spines projecting from dorsal surface of basal lobes (Fig. 26); cluster of 8-25 apically curved smaller spines projecting from anterodorsal surface of basal lobes; inner pendant margins of basal lobes bearing hairs (Fig. 25). Aedeagus lightly sclerotized, reddish brown; ventral valves blunt, slightly divergent at apex, projecting a little beyond dorsal valves; lateral processes broad; dorsal parameres compressed, blade-like, projecting dorsad; ventral parameres absent (Figs. 17, 27).

Abdomen of female: Terga 1-6 dark brown to black, corresponding sterna sordid yellowish brown to dark brown. Segments 7-10 dark brown. Cerci black. Subgenital plate of sternum 8 (Fig. 28) yellowish brown to dark brown, notched and whitened apically, bearing setae on each side of notch and along outer margin, with or without laterobasal translucent, membranous areas. Axial portion of genital plate of variable length, anterior apodemes straight, only slightly divergent; arms of distal plate long, twisted basally (Fig. 29).

Body length: Male, 12.3-15.6 mm; female, 9.0-14.5 mm. *Length of fore wing:* Male, 12-13.6 mm; female, 7.9-14 mm.

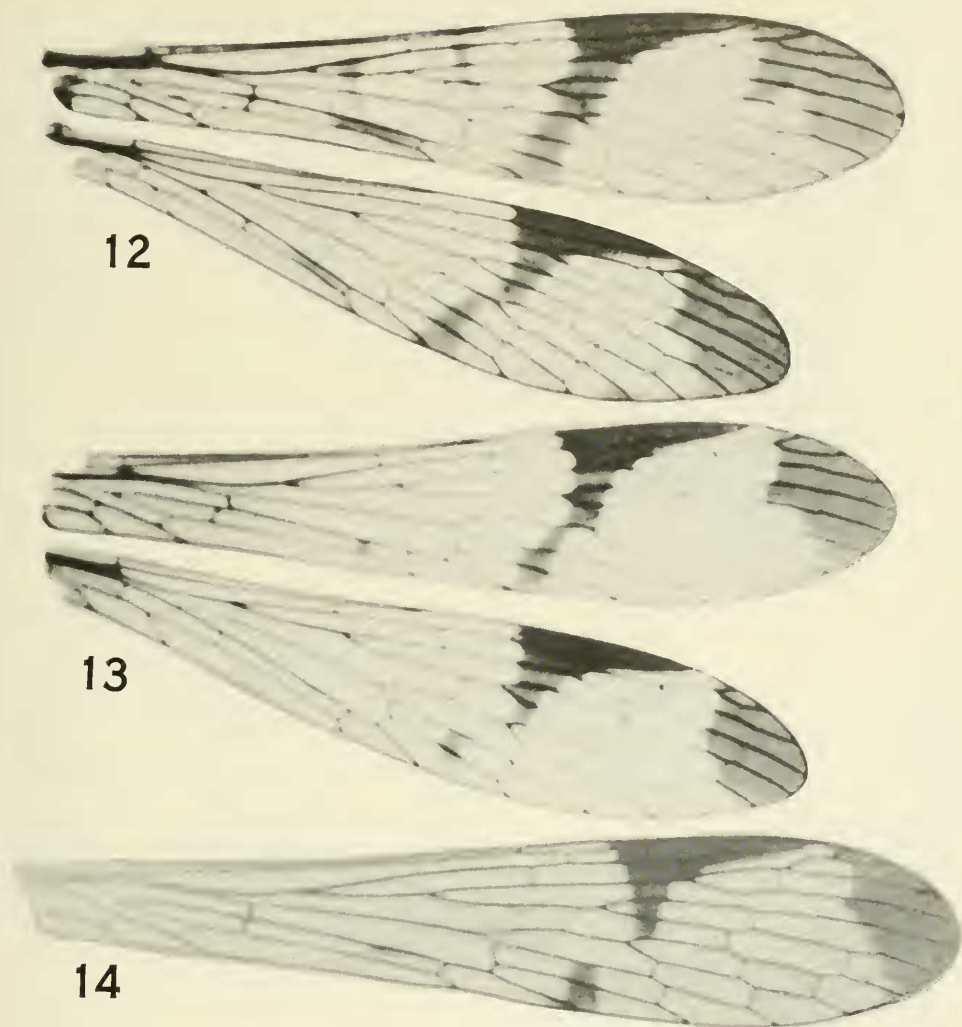
Holotype: Male, collected at Bahia, Java (no date recorded), by S. Müller.

Additional specimens examined: West Java: 1 ♂, Mt. Malang, Tengh, Djampang, 200-800 m, Jan. 1940, Walsh; 2 ♂♂, the same data as above, except Dec. 1937, Walsh and 1931, Betrem; 13 ♂♂, 14 ♀♀, Omg. Sukanegara, Djampang, 700-1000 m, 23 and 28 Dec. 1931, Lieftinck; 2 ♂♂, the same data as above, except 700 m, 19 April 1935, Toxopeus; 1 ♂, 1 ♀, Bibidjilan, Banten (district) south

coast, low country, 1937, Walsh; 1 ♂, 2 ♀♀, Mt. Bunder, Salak, 6 April 1931, Lieftinck; 2 ♂♂, Depok, Karang, 26 Dec. 1920 and 17 Feb. 1924; 2 ♀♀, Preanger, 1500 m, Oct. 1937, Jacobson; 1 ♂, 1 ♀, Mt. Gedeh, 1200-1700 m, Dec. 1912 and 12 Dec. 1929, Jacobson; 17 ♂♂, 18 ♀♀, Mt. Gedeh, Tapos, 700-800 m, 1 Nov., Apr. 1933 and Aug. 1936, Kalshoven; 1 ♀, same data as above, except 16 Oct. 1932, Lieftinck; 3 ♂♂, 6 ♀♀, Mt. Gedeh, Tapos, 1200 m, without date, Kalshoven; 4 ♂♂, 4 ♀♀, Mt. Guntur, Kamodjang, 1400 m, May 1935 and Sept. 1938, Overbeck; 3 ♂♂, 5 ♀♀, Mt. Karang, Bantam, 800 m, 27 May 1931, Lieftinck; 1 ♀, the same data as above, except 1000 m, Oct. 1930, Paine; 8 ♂♂, Kawa Kamodjan, near Garut, Mt. Guntur, 1450 m, May 1935, Overbeck; 1 ♀, Mt. Madiun, Java, 1200 m, 10 Jan. 1930, Leeuwen; 1 ♀, Mt. Manglajang, Preanger, 1400 m, 11 May 1931, Toxopeus; 2 ♂♂, 1 ♀, Mt. Megamendung, 800-1000 m, 27 March and 25 Sept. 1932, Lieftinck; 1 ♂, Pangerango, Oct. 1908, Jacobson; 1 ♀, Pateungteum, 1300 m, 24 Nov. 1935, Toxopeus; 1 ♂, 2 ♀♀, Patjet, Mt. Bésér, 1300 m, 30 Sept. 1934 and 10 March 1940, Lieftinck; 1 ♂, 1 ♀, Pelabuanratu (Wynkoops Bay), southern West Java, low country, Nov. 1935; 1 ♀, Pantjar Mts., Mt. Gedeh, 1500 m, 8 July 1931, Tutbing; 1 ♂, Preanger, Piepers; 1 ♀, Radjamandala, 335 m, June 1935, Jacobson; 2 ♂♂, Selabintana, near Sukabumi, Mt. Gedeh, 1000 m, Dec. 1938, Walsh; 5 ♂♂, 15 ♀♀, Sukabumi; 1 ♂, 3 ♀♀, Mt. Tangkubanprahu (Tangkuban Prah), Preanger, 1333-1700 m, 4 Jan. 1924 and Jan. 1936, Drescher; 4 ♂♂, 5 ♀♀, the same data as above, except 1400 m, 3 Nov. 1940, Olthof; 2 ♂♂, 3 ♀♀, Tjibodas, Mt. Gedeh, 1400 m, 22 May 1935, Vecht; 3 ♀♀, the same data as above, except 1550-1700 m, 27 July 1930 and 28 March 1932, Lieftinck; 1 ♀, Tjomas, Warung Loa, Salak, 9 Nov. 1932, Lieftinck; 1 ♂, 2 ♀♀, Tjipeundeng, Lewuhibiang, 900 m, 22 July 1934, Lieftinck; 5 ♂♂, 1 ♀, Tjisarua, Mt. Gedeh-complex, 1050 m, 6 July 1930, Lieftinck; 9 ♂♂, 1 ♀, Tjisarua, Mt. Panggerango, Mt. Gedeh, 1000-1400 m, 27-30 Aug. 1931, 2 Jan. 1936, 30 May 1937, and 16 April 1950, Lieftinck; 3 ♂♂, Mt. Tjisura, Tengah, Djampang, 500 m, Sept. 1932, Walsh; 2 ♀♀, Ungaran Gunung, 800-1200 m, Oct. 1909, Jacobson.

Central and North Java: 2 ♂♂, 3 ♀♀, Kaliurang, Djokjakarta, C. J., low country, Nov. 1936, Overbeck; 2 ♂♂, Mt. Muria, Macrodjambangan, N. J., 1000 m, 14 and 17 Dec. 1935, Walsh; 3 ♂♂, 10 ♀♀, Mt. Raung, Bajukidael, C. J., 500-800 m, 8 May, Sept. and Dec. 1932, Lucht; 4 ♂♂, 4 ♀♀, Mt. Telamojo, res. Kedu, C. J., 1200-1400 m, 29 Oct. 1939, Lieftinck; 2 ♂♂, 4 ♀♀, Tjolo, Muria Mts., C. N. J., 800 m, 20 and 24 Oct. 1939, Lieftinck.

East Java: 6 ♂♂, 9 ♀♀, Blawan, Idjen Plateau, 950 m, 12 Dec. 1934, 15 March and 26 Dec. 1935, 5 May and 13 Dec. 1936, Lucht; 1 ♂, 1 ♀, Mt. Kendeng, 2000 m, 13 Nov. 1933, Lucht; 2 ♂♂,



FIGS. 12-14. *Neopanorpa muelleri* (Weele), wings, showing variation in degree of pigmentation. 12, specimen from West Java. 13, specimen from Central Java; note broken pterostigmal band in hind wing, a character used by Weele in differentiating subspecies *ungaranensis* from typical *muelleri*. 14, fore wing only of specimen showing broken pterostigmal band. See also Figs. 6-11.

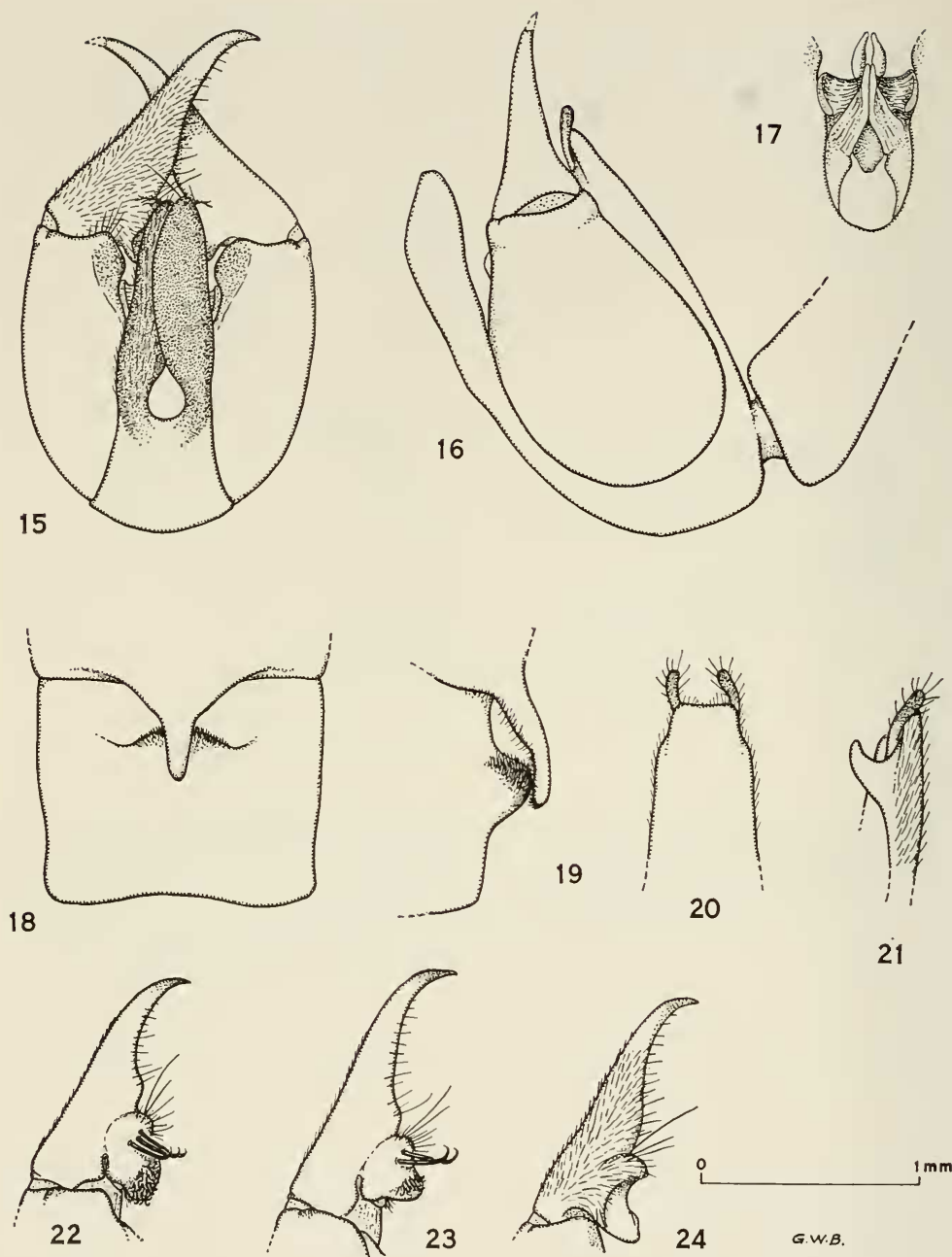
1 ♀, Ongop-ongop, Idjen Mts., 1600-1850 m, May 1924, Dammerman and 27 Dec. 1935, Toxopeus.

Sumatra: 1 ♂, Air Tarbis, Dec. 1913, Jacobson; 4 ♀♀, Brastagi, northeastern Sumatra, 950-1400 m, 12 Nov. 1950, Lieftinck; 1 ♂, 4 ♀♀, Giesting, Mt. Tanggamus, southwestern Lampongs, southern Sumatra, 800 m, 27 Dec. 1934, Lieftinck; 1 ♂, 2 ♀♀, Serapai Kur., July 1915, Jacobson; 2 ♂♂, Suban Ajam, July 1916, Jacobson; 4 ♂♂, 3 ♀♀, Tandjunggadang (west coast), 1000-1200 m, Oct. 1925 and Feb. 1926, Jacobson.

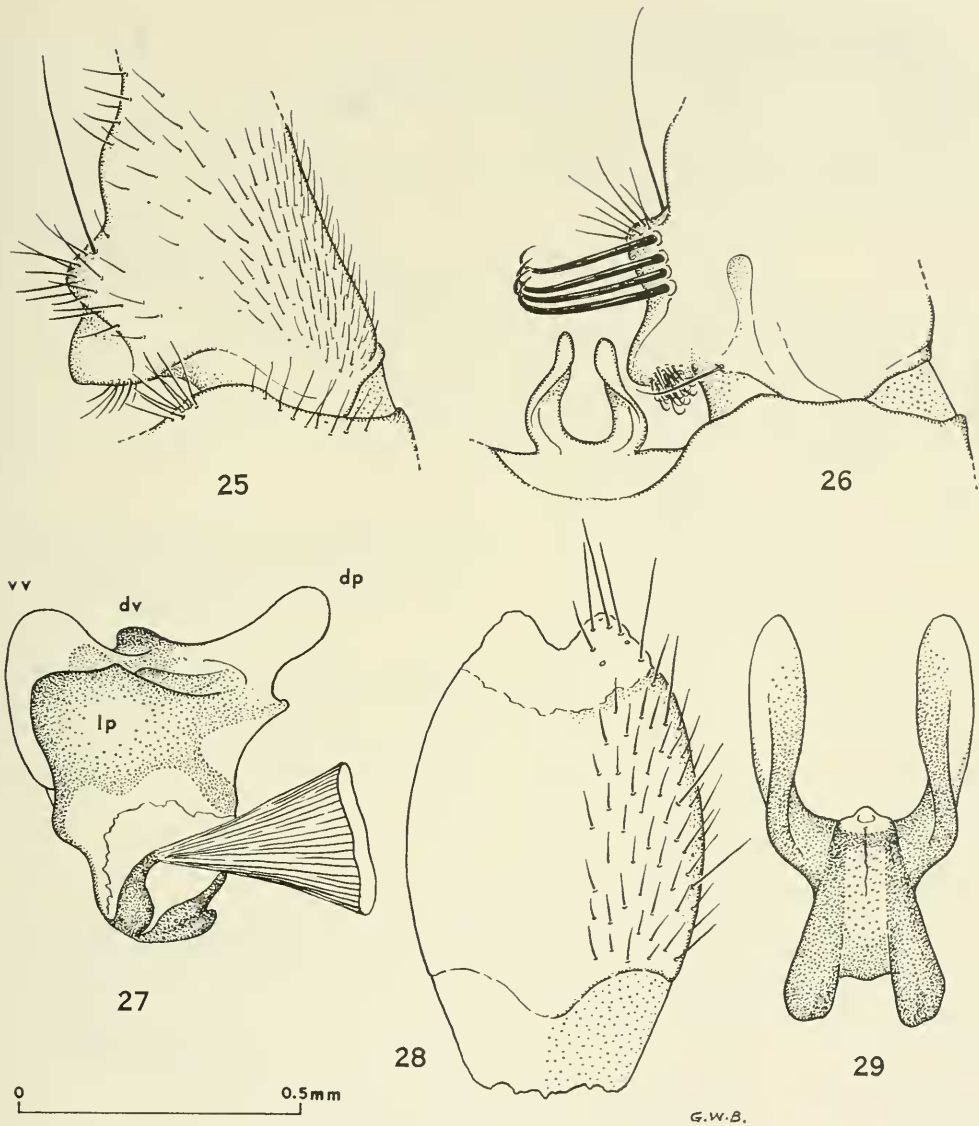
Neopanorpa muelleri is the commonest Indonesian *Neopanorpa*, with the broadest

range of habitats and of vertical or horizontal distribution. It ranges from low country to above 2000 m, throughout the islands of Java and Sumatra, and possibly on Halmahera. This relatively great range probably has helped produce some of the complicated variation within this species.

The wing markings vary (Figs. 6-14) from clear except for the pterostigmal band and reduced apical band to a complete pattern including apical band, pterostigmal



FIGS. 15-24. *Neopanorpa muelleri* (Weele), structural details of male. 15, genital bulb of lectotype, ventral aspect. 16, same, right lateral aspect. 17, aedeagus, lectotype, ventral aspect. 18, abdominal terga 3 and 4, showing notal organ, dorsal aspect, reconstructed from lectotype. 19, same, left lateral aspect. 20, ninth abdominal tergum, lectotype, dorsal aspect. 21, same, right lateral aspect. 22, right dististyle, specimen from Sumatra, dorsal aspect, showing only three large spines and many smaller spines on elongate basal lobe. 23, right dististyle, specimen from Sumatra, dorsal aspect, showing only two large spines and smaller group of small spines on shorter basal lobe. 24, left dististyle, male lectotype of subspecies *ungaranensis* (Weele), ventral aspect, showing prolonged anterior (ventral) portion of basal lobe.



FIGS. 25-29. *Neopanorpa muelleri* (Weele), details of male and female genitalia. 25, base of right dististyle, male lectotype, ventral aspect. 26, base of left dististyle and dorsal parameres, male lectotype, dorsal aspect. 27, aedeagus, male from Ongop-ongop, East Java, right lateral aspect. 28, subgenital plate of female, ventral aspect. 29, genital plate of female, ventral aspect.

band, marginal spot, basal band and basal spot. The apical band varies from a reduced, incomplete type to large with conspicuous proximal prominence or enclosing a small posterior pale spot. The pterostigmal band may be either complete or incomplete, broad or narrow, forked posteriorly or not. The distal branch may be

complete or isolated as a spot. The basal band may be entire, reduced to one or two spots, or absent. Marginal and basal spots are either present or absent. Color variation in *N. muelleri* is not affected by altitude (*i.e.*, the dark form both in body and wings is found both in the mountains and in the lowlands). Hypovalves and disti-

styles may be darkened or not. The basal lobe of the dististyle has a medium-sized concavity (or cup) on all Javanese forms of *muelleri*, but bears a larger cup in all Sumatran specimens. The number of smaller, curved spines on the anterior dorsum of the basal lobe varies from as few as 8 on most Javanese forms to 25 on most Sumatran forms (Fig. 22).

Weele (1909) and some other authors thought certain of these variants were different species, *Neopanorpa muelleri* and *N. angustipennis*. We found no specimens from Indonesia having the same structure and coloration as the holotype of *angustipennis*, supporting the view (Byers, 1965) that the type of *angustipennis* is from Tenasserim (peninsular Burma), not Java. Weele (1909) also described *ungaranensis* as a subspecies of *muelleri*, based on the smaller size of the former and its more reduced wing pattern, but Karny (1923) dissented. As Karny did, we find that variation in body size and color and wing markings occurs in a distribution that cannot sensibly be geographically subdivided, and we judge the nominal subspecies *ungaranensis* to be a variant of *muelleri*. Once, we thought these might be a group of very similar species (and initially sorted these specimens into four "species"), but we prefer the more conservative view that these variant forms represent instead one widespread, variable species.

Neopanorpa hyalinata Esben-Petersen,
1913

Neopanorpa hyalinata Esben-Petersen, 1913:
227-228.

Campodotecnum falcatum Navás, 1914.

Esben-Petersen based his description of *hyalinata* on the male holotype, female allotype, and one male, one female paratypes.

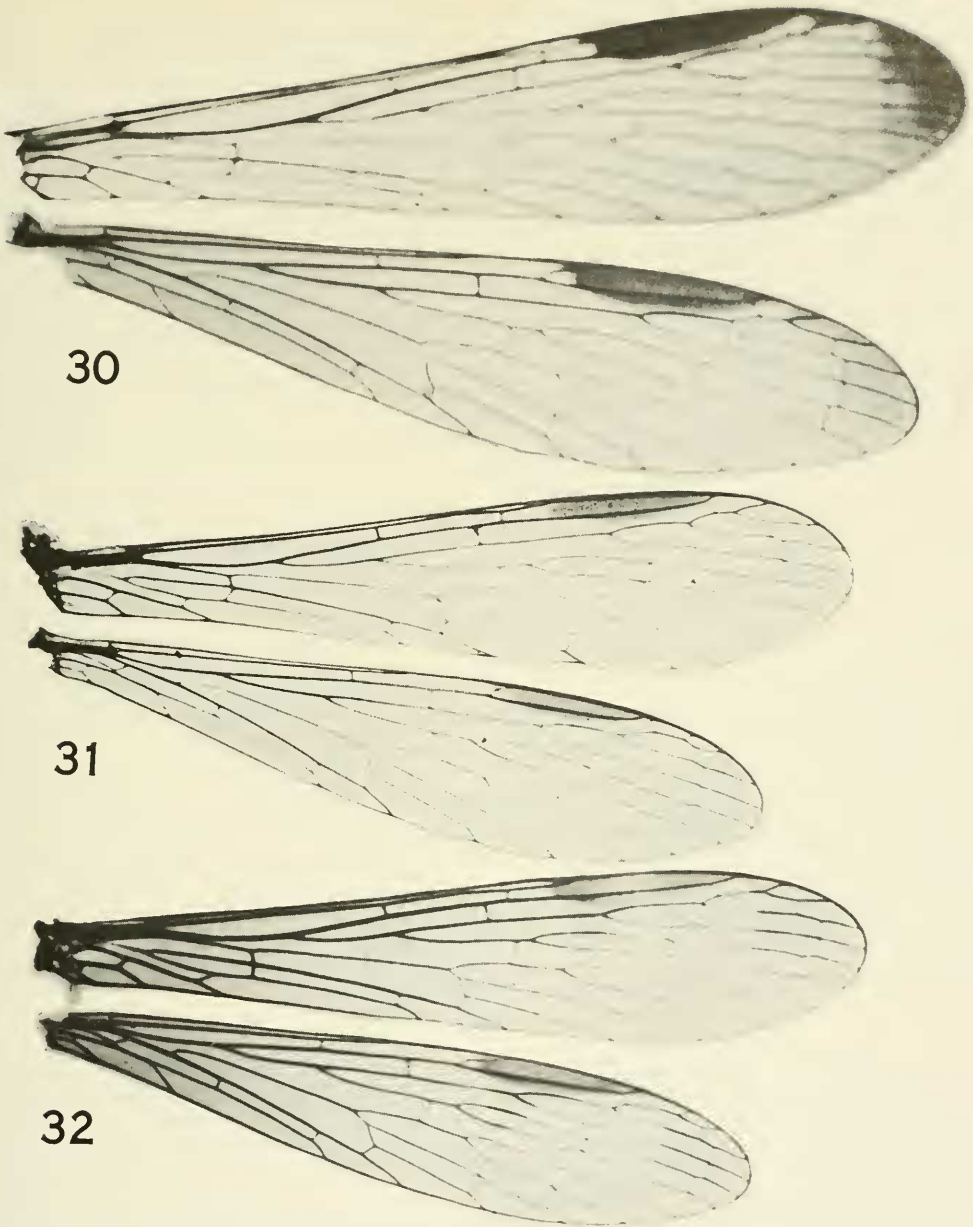
Head: Dorsum glossy black; frons below antennal sockets dark brown; ros-

trum reddish brown anteriorly, yellowish brown laterally and brown apically; mouthparts brown with tips of palps dark brown. Antennal scape brown, pedicel dark brown, basal flagellomeres dull brown, others dull dark brown, flagellum with 44 segments (extreme apex broken in holotype).

Thorax: Pronotum brownish black to black (holotype), bearing 3-4 bristles at each side along anterior margin. Mesonotum and metanotum black. Pleura and coxae pale yellowish brown to sordid brown (holotype). Femora sordid yellowish brown (holotype) to dull dark brown; tibiae brown; tarsi dark brown.

Wings: (Figs. 30-32): Almost colorless, slightly iridescent, with spots dark smoky brown. Apical band greatly reduced, from almost absent to slightly tinged with light brown on distal margin of wing. Pterostigmal band usually absent, pterostigma conspicuous, long and very dark. Behind inner end of pterostigma a small, dark brown spot connected to pterostigma in some specimens. Marginal spot, basal band and basal spot absent.

Abdomen of male: Terga 1-5 brownish black, corresponding sterna yellowish brown to dark brown. Segment 6 black dorsally, blackish brown ventrally. Segments 7-9 brownish black. Posterior process of tergum 3 narrowly triangular (Fig. 36). Hypo valves of sternum 9 widened and overlapping near mid-length, bearing a few long hairs, darkest near base, paler in apical half, narrowed to pointed apex. Tergum 9 pale and emarginate apically. Dististyles slender, dark brown basally, reddish brown distally, outer margins slightly concave near mid-length, abruptly curved near tips. Basal lobes of dististyles concave ventrally, bearing long pale hairs on distal margin and short pale hairs on anterior margin; each with 3-4 long, apically curved, stout, black spines on mesodorsal surface (4 in male syntype), about

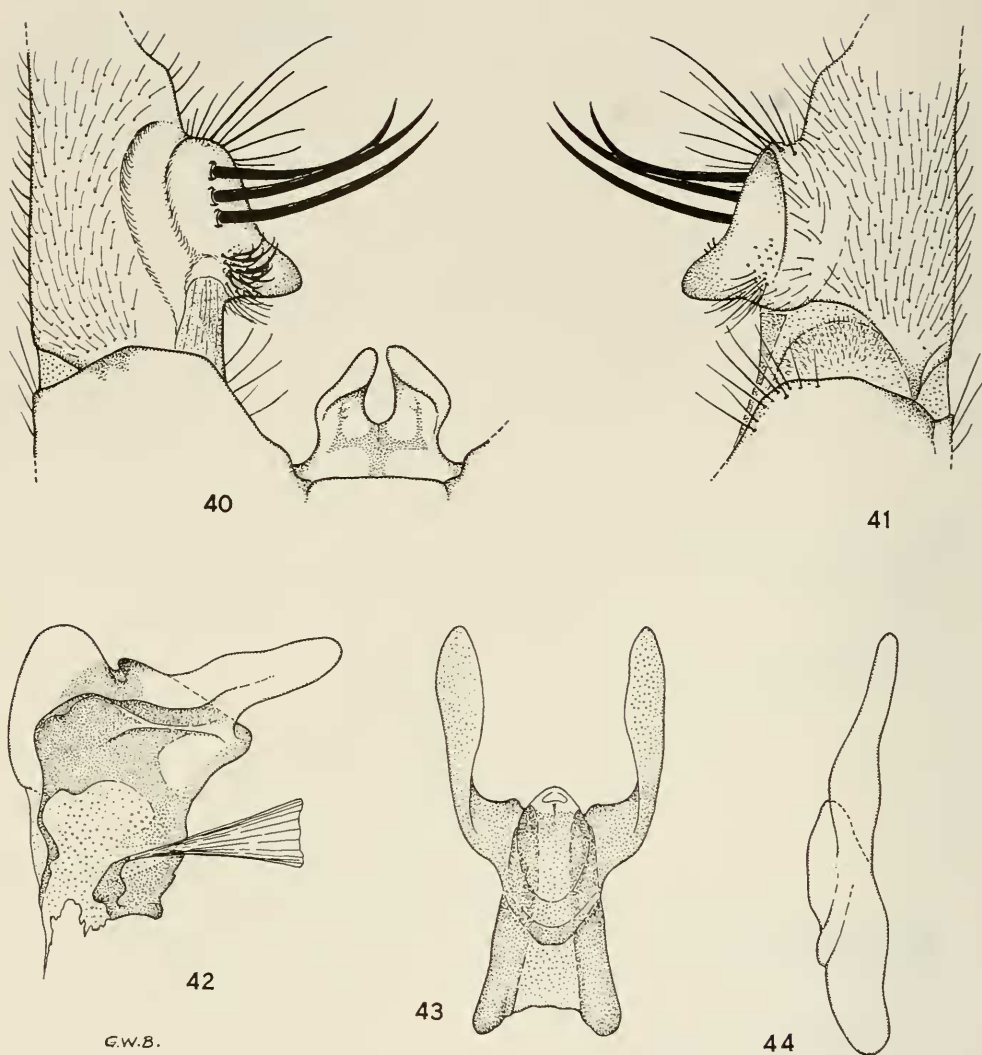


FIGS. 30-32. *Neopanorpa hyalinata* Esben-Petersen, wings, showing variation in wing pattern. 30, typical pattern; note long, dark pterostigma; male, from East Java. 31, male, from East Java. 32, female, from East Java; this pattern also occurs in males.

6 smaller, apically curved spines on antero-dorsal surface (Fig. 40). Ventral valves of aedeagus broad, extending a little beyond dorsal valves (Figs. 33, 42); lateral processes broad; ventral parameres absent, possibly represented by sclerotized bands

in membrane below lateral processes (Figs. 33, 42); dorsal parameres conspicuous, blade-like, apices directed dorsomesad (Fig. 42).

Abdomen of female: Terga 1-6 black, terga 7-10 blackish brown; sterna



FIGS. 40-44. *Neopanorpa hyalinata* Esben-Petersen, details of male and female genitalia. 40, base of right dististyle and dorsal parameres, dorsal aspect; male from Malang, Java. 41, same as 40 except ventral aspect without parameres. 42, aedeagus, right lateral aspect. 43, genital plate, ventral aspect; female from East Java. 44, same as 43, right lateral aspect.

male, Nongkodjadar, Java, Jan. 1911, Jacobson, in Rijksmuseum van Natuurlijke Historie, Leiden; 1 ♂, 1 ♀, (type specimens of *Campodotenum falcatum* Navás), Java, 1891, Fruhstorfer, in Naturhistorisches Museum, Wien. Additional specimens: 5 ♂♂, 4 ♀♀, Tengger Mts., Nongkodjadar, East Java, 1200 m, 2 May 1938, Walsh; 2 ♂♂, 1 ♀, Djunggo, Malang, Java, 22 Dec. 1931, Betrem; 1 ♂,

1 ♀, Ongop-ongop, Idjen, Java, 1850 m, May 1924, Dammerman; 2 ♀♀, Sumberbrantas, Mt. Ardjuno, East Java, 1500 m, Jan. 1936, Overbeck; 2 ♀♀, Bodjongkalong, Djampang, West Java, 300 m, June 1938, Walsh.

We place this species in the *muelleri* group because of the large spines on the basal lobes of the dististyles and other significant details of the male and female

genitalia. It is easily recognized by the hyaline, slightly marked wings, for which the species is named, by its conspicuous pterostigma, and by the somewhat more blackish body color than that seen in other species. We find that the small spot below the inner end of the pterostigma is also present in some females (absent according to Esben-Petersen, 1913).

Neopanorpa fuscicauda, new species

Description based on 2 males, 5 females, pinned.

Head: Dorsum glossy black; frons below antennal sockets dark brown; rostrum brown anteriorly, yellowish brown laterally; mouthparts brown. Antennal scape and pedicel brown, flagellum dull dark brown with 41 segments (both antennae missing from holotype).

Thorax: Pronotum black, bearing 5 bristles at each side along anterior margin. Mesonotum and metanotum black. Pleura and coxae yellowish brown (holotype) to reddish brown or blackish brown (2 females). Femora yellowish brown; tibiae and tarsi brown (holotype) to dark brown.

Wings (Fig. 45): Almost colorless, slightly iridescent, with markings dark

smoky brown. Apical band incomplete posteriorly, with small proximal prominence in one female. Pterostigmal band complete but not forked posteriorly, narrowly joined to apical band along anterior margin, narrow in males, broader in females. Marginal spot, basal band and basal spot usually absent (marginal spot present and basal band represented by a spot between end of Cu_1 and Cu_2 in one female).

Abdomen of male: Terga 1-5 brownish black; sterna 2-5 sordid yellowish brown. Segment 6 brownish black. Segments 7-8 brown basally, dark brown distally. Segment 9 blackish brown (holotype) to dark brown. Posterior process of tergum 3 narrowly triangular (as in *muel-leri*), extending about half-way across tergum 4. Hypovalues of sternum 9 blackish brown (holotype) to dark brown at base, remainder grayish brown, with inner margins separated or slightly overlapping near mid-length, outer margins infolded dorsally, the folded edges subparallel in ventral aspect (Fig. 48). Tergum 9 slightly emarginate apically (Fig. 49). Basistyles blackish brown (holotype) to dark brown; dististyles blackish brown (holotype) to dark brown basally, brown apically. Basal

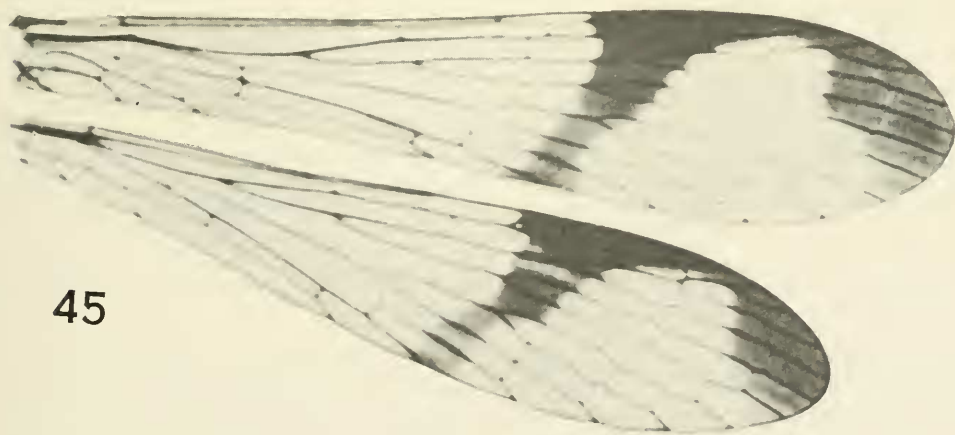
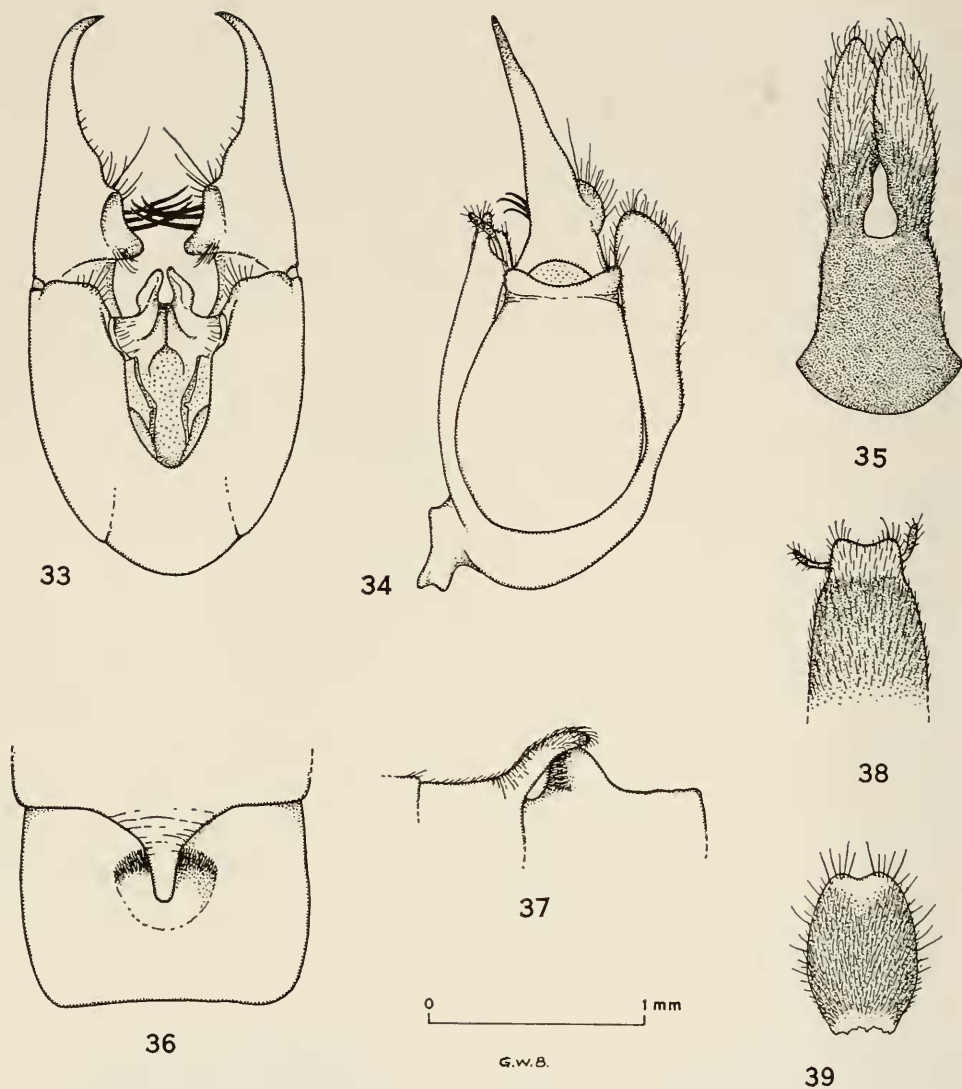


FIG. 45. *Neopanorpa fuscicauda*, new species, wings of female paratype.



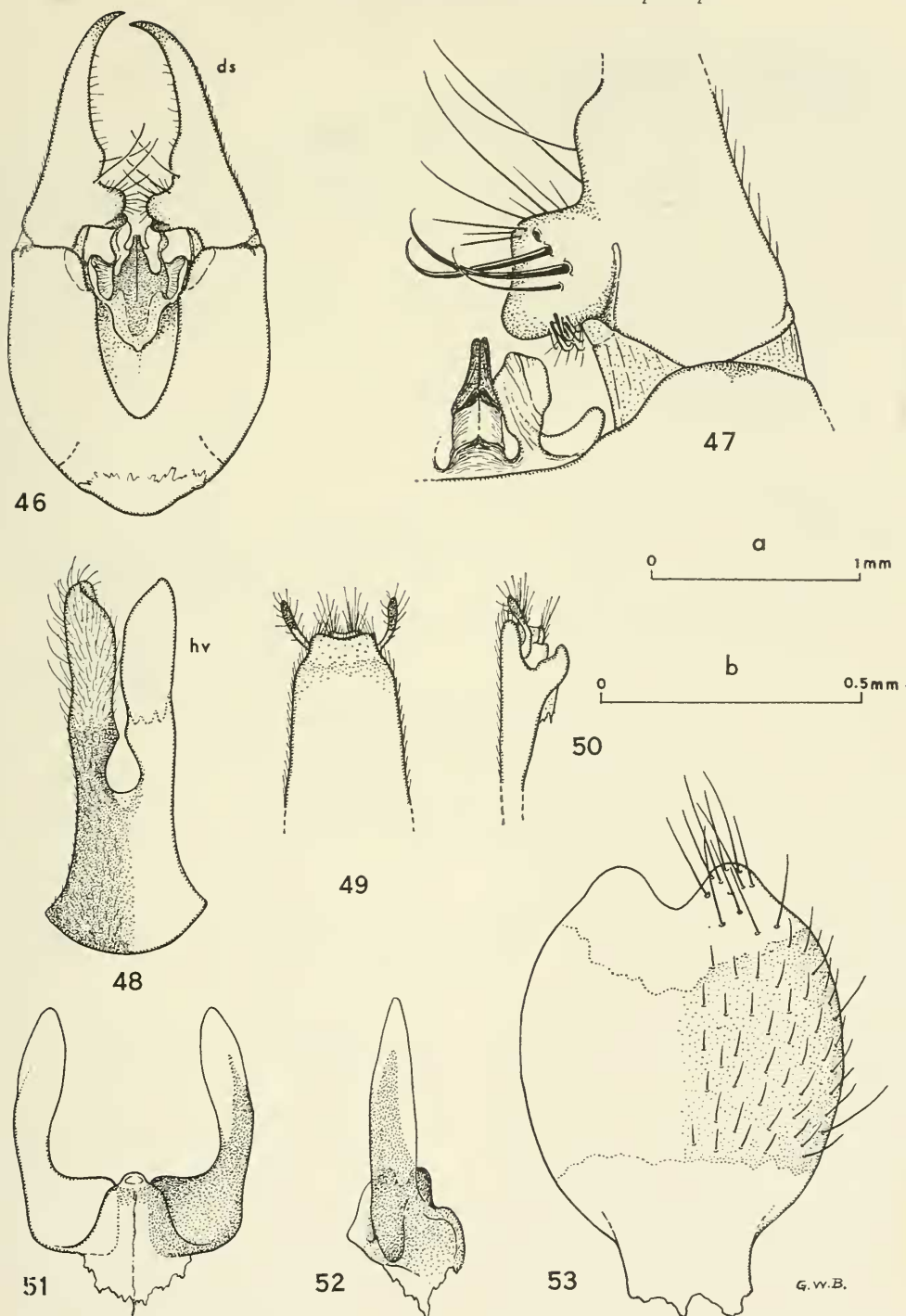
FIGS. 33-39. *Neopanorpa hyalinata* Esben-Petersen, structural details. 33, genital bulb, ventral aspect, ninth sternum removed to show aedeagus; male from Malang, Java. 34, same as 33, left lateral aspect, ninth sternum in place. 35, ninth abdominal sternum and hypovalves, ventral aspect, shaded to indicate color pattern; male from Malang, Java. 36, reconstruction of abdominal terga 3 and 4, showing notal organ, dorsal aspect; male holotype. 37, same as 36, left lateral aspect. 38, ninth abdominal tergum, dorsal aspect; male from Malang. 39, subgenital plate, ventral aspect; female from East Java.

1-5 light brown (allotype) to sordid brown, sterna 6-7 brown to dark brown. Subgenital plate of sternum 8 dark brown, slightly notched and whitish apically (Fig. 39), bearing long setae at each side of notch and on lateral margins, membranous basally. Axial portion of genital plate

elongate, arms broad and twisted basally (Fig. 43).

Body length: Male, about 13-15 mm; female, about 10-12 mm. *Length of fore wing:* Male, 12.8-13.5 mm (holotype 13.2 mm); female, 12.1-12.9 mm.

Holotype: Male, and allotype, fe-



FIGS. 46-53. *Neopanorpa fuscicauda*, new species, details of male and female paratypes. 46, genital bulb, ventral aspect, with sternum 9 removed to show aedeagus; ds—dististyle. 47, base of left dististyle and dorsal parameres, dorsal aspect. 48, ninth abdominal sternum and hypovalves (hv), ventral aspect, partly shaded to indicate color pattern. 49, ninth abdominal tergum, dorsal aspect. 50, same as 49, left lateral aspect. 51, genital plate of female, ventral aspect. 52, same as 51, right lateral aspect. 53, subgenital plate, ventral aspect, partly shaded to indicate color pattern. Scale a—FIGS. 46, 48-50; scale b—FIGS. 47, 51-53.

lobes of dististyles subrectangular, with long hairs on posterior surface, 2-3 stout, black, apically curved spines projecting from mesodorsal surface, and about 8 smaller, apically curved spines on anterodorsal surface; some pale hairs arising on anterior margin (Fig. 47). Ventral valves of aedeagus long and slender, projecting beyond dorsal valves in dorsal aspect (Fig. 47); lateral processes deeply concave; ventral parameres absent; dorsal parameres well developed, broadly triangular, mesally concave blades, projecting somewhat dorsad and connecting ventrally to sides of ventral valves (Fig. 46). (Note that entire aedeagus as shown in Fig. 46 may be atypically displaced upward, or caudad).

Abdomen of female: Terga 1-6 black; sterna 2-5 yellowish brown to dark brown (allotype), sternum 6 dark brown. Terga 7-9 brownish black, corresponding sterna dark brown. Cerci dark brown. Subgenital plate of sternum 8 short and broad, mostly dark brown, notched and with large whitish area apically, bearing several setae at each side of notch, otherwise sparsely hairy; basal portion slender, pale, membranous. Axial portion of genital plate very short, conical; arms slender, sclerotized on outer basal margins, translucent on inner margins (Fig. 51); base of each arm expanded to form a subquadrate plate, the two plates separated by a median cleft above apex of axial portion and each darkly sclerotized adjacent to axial portion (Fig. 51).

Body Length: Male, about 12-15 mm (holotype 15 mm); female, about 9-15 mm (allotype 11 mm). *Length of fore wing:* Male, 12.2-13 mm (holotype 13 mm); female, 12.3-13.3 mm (allotype 13 mm).

Holotype: Male, Tengger Mts., Nongkodjadar, East Java, 1200 m, 5 May 1938, Walsh. Allotype, 1 ♂ and 4 ♀ paratypes, same data as holotype; 1 ♀, same data as holotype, except Jan. 1911,

Jacobson. Holotype, allotype and 3 ♀ paratypes in the Rijksmuseum van Natuurlijke Historie, Leiden; 1 ♂, 1 ♀ paratypes in the Snow Entomological Museum, The University of Kansas.

We place this species in the *muelleri* group because of its wing pattern and the spiniferous basal lobes of the male dististyles. It can be easily recognized by its dark brown to blackish brown genital bulb, from which the species is named (also found in some *muelleri* but not as uniformly as *fuscicauda*) and the characteristic dorsal parameres of the aedeagus (extending ventrally alongside the ventral valves). Females can be identified by the unique structure of the genital plate (base of each arm expanded to form a subquadrate plate).

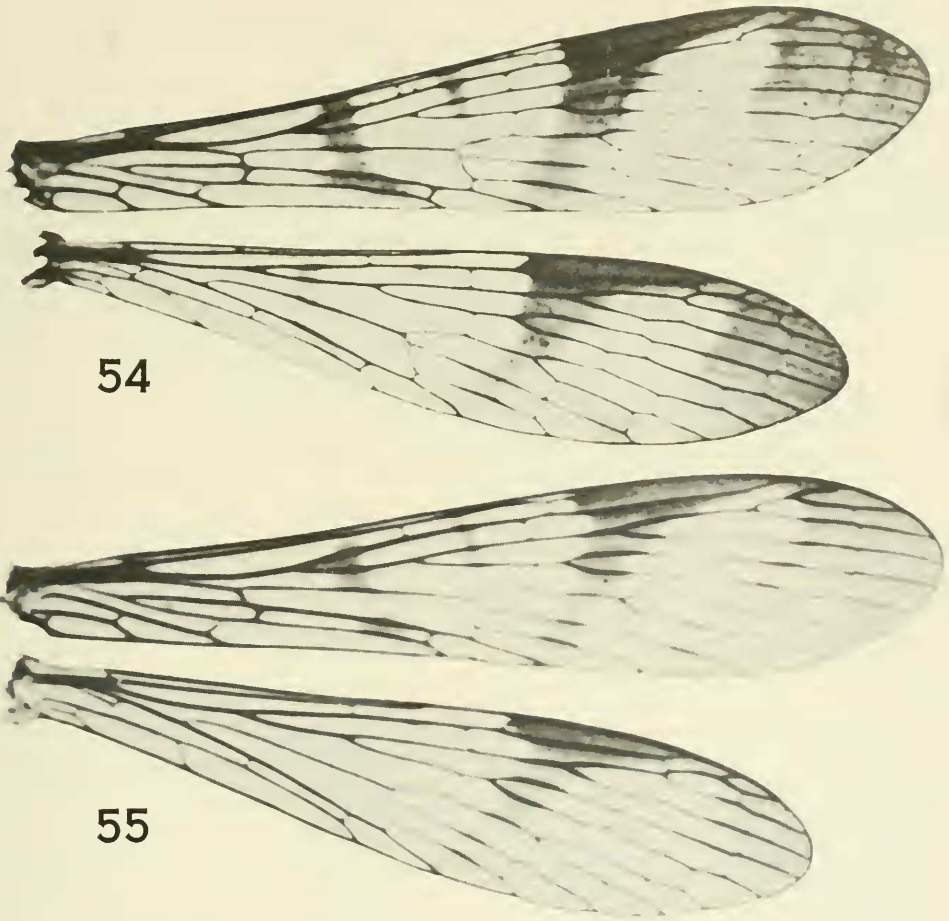
Neopanorpa umbonata, new species

Description based on 15 males, 21 females, pinned.

Head: Dorsum glossy brownish black (holotype) to black; frons below antennal sockets dark brown; rostrum brown with yellowish brown median and lateral stripes; mouthparts brown except tips of palps dark brown. Antennal scape yellowish brown, pedicel brown, flagellum mostly dull dark brown, brown at base, with 42 flagellomeres.

Thorax: Pronotum brownish black, with 3-4 bristles at each side along anterior margin. Mesonotum and metanotum brownish black. Pleura mostly yellowish brown (holotype) to reddish brown, dark brown on episternum near wing base. Coxae yellowish brown (holotype) to reddish brown. Femora yellowish brown; tibiae and tarsi dark brown.

Wings (Figs. 54, 55): Nearly colorless, slightly iridescent, with bands and spots smoky dark brown. Apical band interrupted posteriorly or including variously shaped clear areas. Pterostigmal band with complete proximal branch, dis-

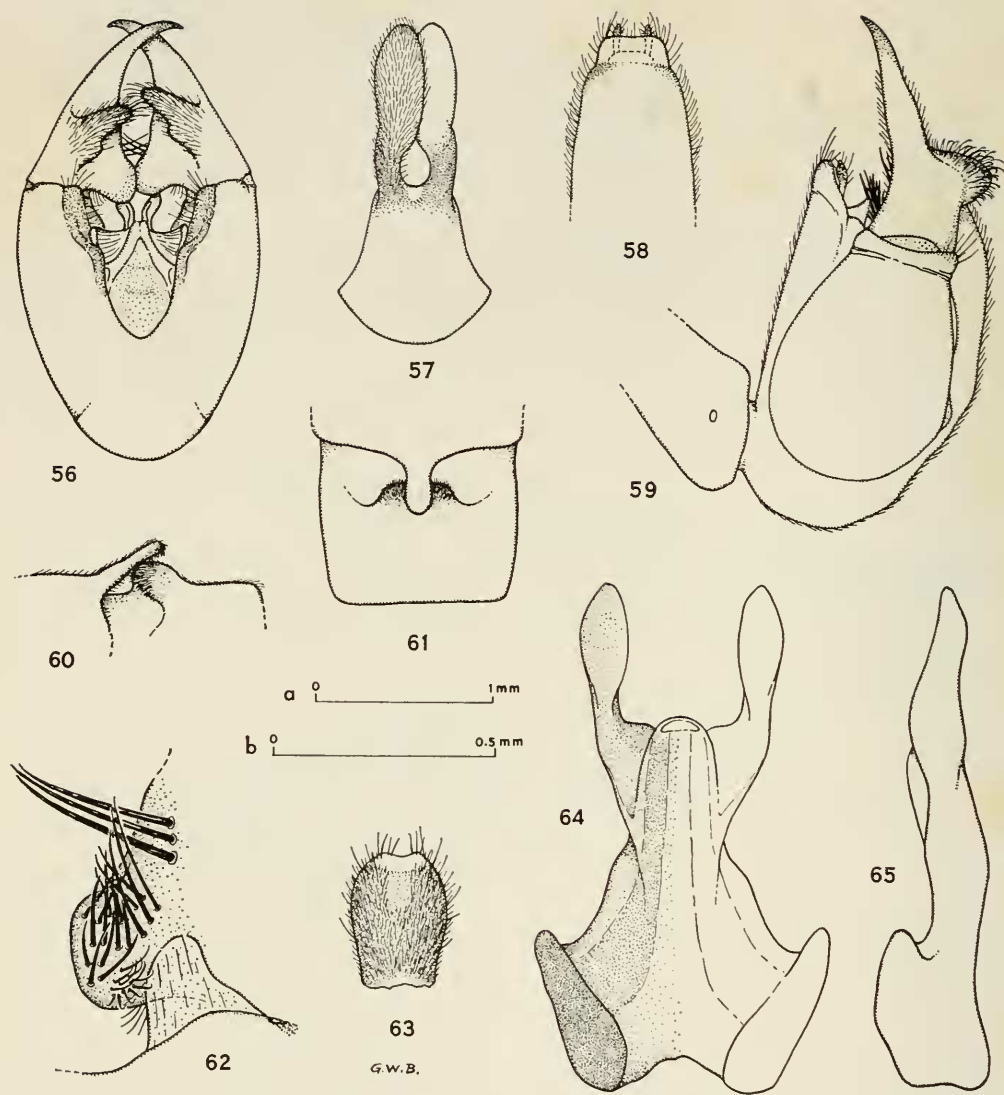


FIGS. 54-55. *Neopanorpa umbonata*, new species, wings of male paratypes from two localities in southern Sumatra, showing variation in pigmentation. 54, male from Tandjong Sakti. 55, male from Wai Lima, Lampongs.

tal branch reduced to spot on posterior wing margin. Marginal spot small (holotype) to conspicuous. Basal band slender, usually interrupted in cell M (holotype), complete in some paratypes. Basal spot absent.

Abdomen of male: Terga 1-3 brownish black, terga 4-5 dark brown; sterna 2-5 usually yellowish brown. Segment 6 dark brown. Segments 7-9 brownish yellow. Posterior process of tergum 3 (Fig. 61) narrow with subparallel sides, extending about half-way across tergum 4. Hypovalves of sternum 9 dark brown at base to brown at tip, inner margins over-

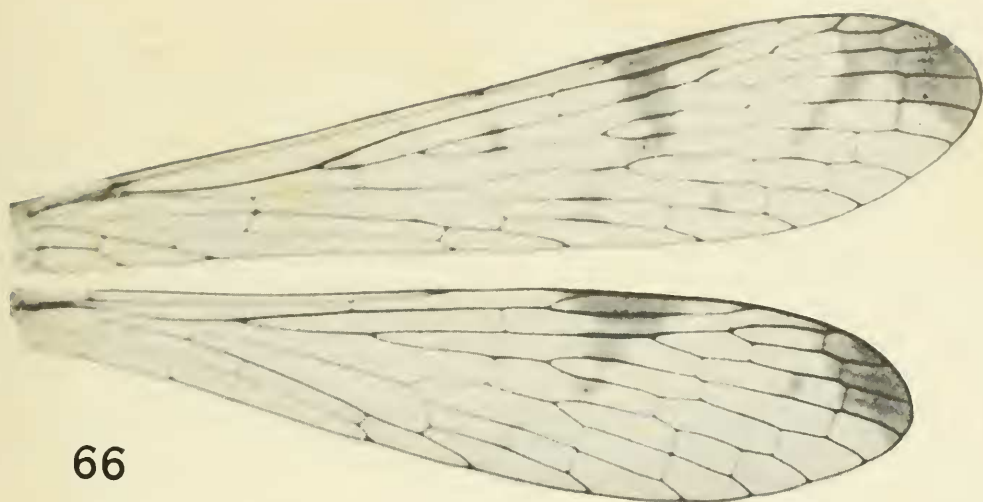
lapped near mid-length, tips usually concealed by basal lobes of dististyles. Tergum 9 (Fig. 58) narrowed just before truncate apex, elongate, nearly concealing cerci. Basistyles slender, glabrous and darkly sclerotized mesally. Dististyles dark brown, their outer margins generally straight in basal two-thirds, then smoothly curved toward tips (Fig. 56). Basal lobes of dististyles divided into thin, expanded posteroventral and anterodorsal portions together forming a large cup-like recess (Fig. 56); posteroventral portion directed ventrocaudad, usually covering tips of hypovalves, covered with long hairs; more



FIGS. 56-65. *Neopanorpa umbonata*, new species, structural details of holotype and male and female paratypes. 56, genital bulb of male, ventral aspect, ninth sternum removed to show aedeagus. 57, ninth abdominal sternum and hypovalves, ventral aspect, partly shaded. 58, ninth abdominal tergum, dorsal aspect, most hairs omitted. 59, genital bulb, left lateral aspect; holotype. 60, abdominal segments 3 and 4, left lateral aspect, showing notal organ; holotype. 61, same as 60, dorsal aspect. 62, basal lobe of left dististyle, dorsal aspect. 63, subgenital plate of female, ventral aspect. 64, genital plate of female, ventral aspect. 65, same as 64, right lateral aspect. Scale a—Figs. 56-61, 63; scale b—Figs. 62, 64-65.

Wings (Fig. 66): Tinged with yellow and slightly iridescent, markings smoky brown. Apical band incomplete, bearing variously shaped proximal prominence in some paratypes, reduced almost to a light, small spot in one (teneral) para-

type. Pterostigmal band incomplete, reduced to a small spot (holotype), or only stigma pigmented (two paratypes), triangular and including stigma in females. Marginal spot absent in all males, present in females. Basal band absent.



66

FIG. 66. *Neopanorpa angustiapictula*, new species, right wings of female paratype.

Abdomen of male: Terga 1-3 blackish brown, terga 4-5 dark brown (holotype) or dark brown in the middle, grading into light to yellowish brown at margins (paratypes); sterna 2-5 yellowish brown to light brown (holotype). Segment 6 brown dorsally, reddish brown ventrally; dark brown in one paratype. Segments 7-9 reddish brown, 7-8 much longer than in any other Javanese *Neopanorpa* (Fig. 71). Posterior process of tergum 3 elongate, stout, fringed with hairs at base, extending across about two-thirds length of tergum 4 (Figs. 69, 70). Elevated process on tergum 4 bifurcate. Smooth, shiny area on tergum 4 beneath posterior process of 3. Male genitalia (based mainly on dissected paratype): Hypovalues of sternum 9 apically and mesally darkened, long, expanded and overlapping at mid-length, narrowed and bearing sparse long hairs on apical one-third (Fig. 67). Ninth tergum (Fig. 72) broad, reddish brown (holotype) to yellowish brown, paler and almost squarely truncate apically. Cerci pale basally, dark brown apically. Genital bulb short and stout. Dististyles short, their outer margins generally straight or slightly concave but abruptly curved at tips (Fig. 67).

Basal lobes of dististyles large, subrectangular in posterior mesal aspect, flattened, darkened, bearing many long yellowish hairs (Figs. 68, 73). Mesal margins of dististyles above basal lobes also somewhat pointed, bearing a long setae dorsally (Fig. 73). Aedeagus complex, with conspicuously projecting ventral parameres (Figs. 71, 74-76). Ventral valves small, projecting caudad only about as far as dorsal valves; dorsal valves concealed between dorsal parameres. Ventral parameres thick, darkly sclerotized, strongly curved ventrad and caudad, abruptly narrowed to mucronate tip (Figs. 74, 76). Dorsal parameres thickened, bluntly rounded, each continued dorsocephalad as a thin, slightly hooked blade (Figs. 74, 75). Lateral processes complexly divided into two parts separated by a deep, sclerotized pocket (Fig. 74).

Abdomen of female: Terga 1-6 dark brown (allotype) to blackish brown, corresponding sterna dull brown to light brown (allotype). Segments 7-8 brown basally, reddish brown apically (allotype) or entirely reddish brown. Segments 9-10 blackish brown (allotype) to reddish brown basally, dark brown apically. Cerci black. Subgenital plate yellowish, broadly

dorsal portion of lobe with 2-3 long, stout, black spines projecting from its postero-dorsal surface, about 12 smaller black spines on mesodorsal surface and about 9 small apically curved spines on anterodorsal surface (Fig. 62). Ventral valves of aedeagus divergent basally, extending slightly beyond dorsal valves and lateral processes; ventral parameres absent; dorsal parameres conspicuous, tongue-shaped blades, close together basally but with apices divergent (Fig. 56).

Abdomen of female: Terga 1-6 brownish black, corresponding sterna dull yellowish brown (allotype) to dull brown. Terga 7-10 dark brown; sternum 7 brown; cerci black. Subgenital plate of sternum 8 (Fig. 63) brown, whitish and notched apically, bearing long setae at each side of notch, weakly sclerotized anterolaterally. Axial portion of genital plate, greatly enlarged anteriorly (Fig. 64), bearing conspicuously protruding, ventral processes (Fig. 65). Arms broad, slightly twisted near base.

Body length: Male, about 13-15 mm (holotype 14 mm); female, about 9-11 mm (allotype 11 mm). *Length of fore wing:* Male, 11.9-14 mm (holotype 11.9 mm); female, 12.2-13.3 mm (allotype 12.6 mm).

Holotype: Male, Giesting, Mt. Tanggamus, southwestern Lampongs, southern Sumatra, 500-800 m, 24 and 27 Dec. 1934, Lieftinck. Allotype, 10 ♂♂, 15 ♀♀, same data as holotype; 1 ♂, 3 ♀♀, same data as holotype, except 500-1000 m, 29 June and Sept. 1933-34, Toxopeus; 1 ♂, 1 ♀, Lampongs, Wai Lima, southern Sumatra, 11 Dec. 1921, Karny; 1 ♂, Muara, Sako, Sumatra, Oct. 1915, Jacobson; 1 ♀, Fort de Kock (Bukittingi), Sumatra, 920 m, 1924, Jacobson; 1 ♂, Tan-duong Sakti, Benkulen, southern Sumatra, 650 m, June 1935, Walsh. Holotype, allotype and most paratypes in the Rijksmuseum van Natuurlijke Historie, Leiden; 2 ♂, 1 ♀ paratypes in the Snow Entomo-

logical Museum, The University of Kansas.

We place this species in the *muelleri* group because of its wing pattern, the large spines on the dorsal surface of the basal lobes of the dististyles and the structure of the aedeagus in males. It can be easily recognized by the prominent, rounded components of the basal lobe of the dististyle, from which the species is named. Especially, the entirely exposed, ventro-caudally directed part is conspicuous and characteristic. For the female, the peculiar structure of the genital plate (protruding processes on anteroventral axial portion) is diagnostic.

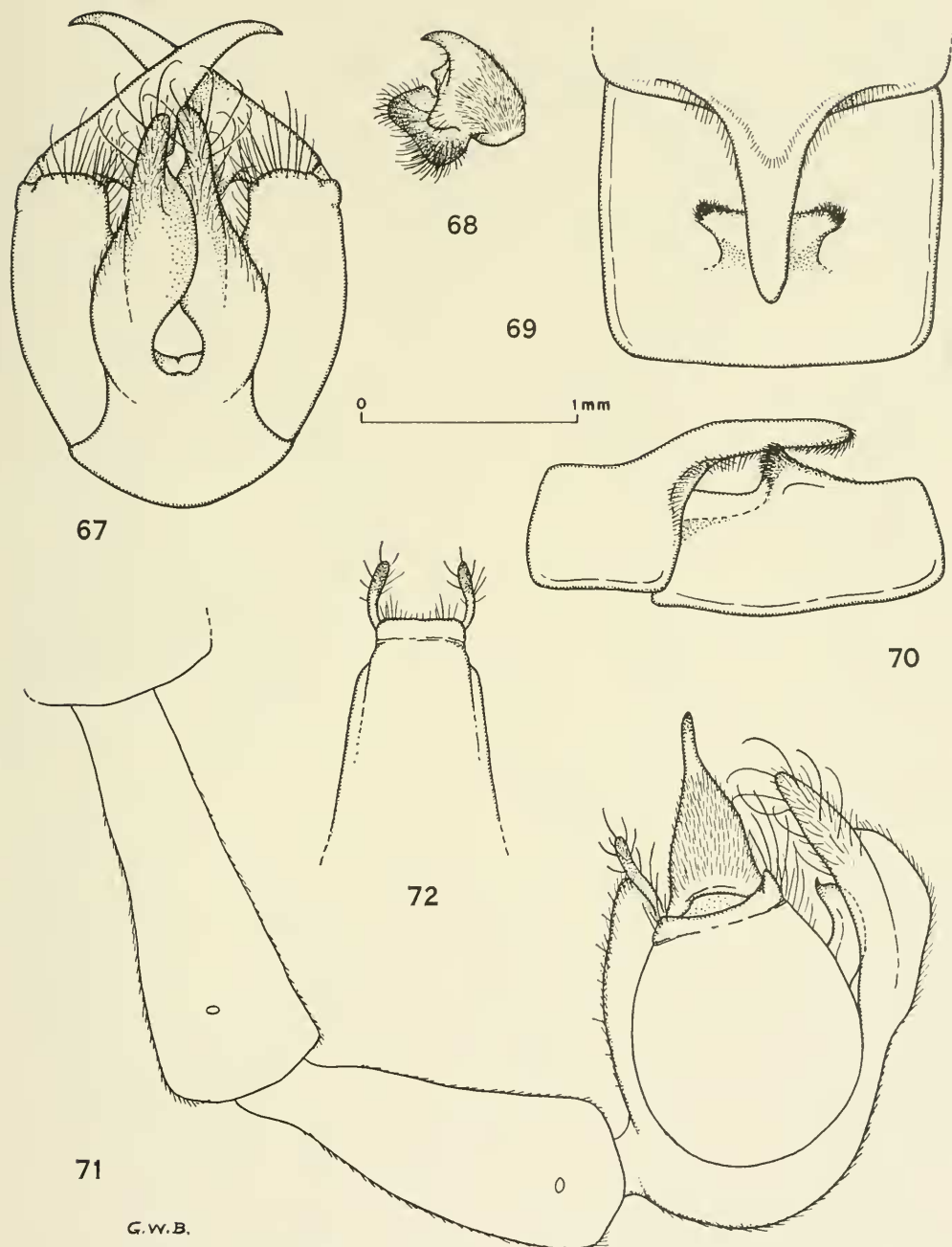
NEOPANORPA ANGUSTIAPICULA Group

Neopanorpa angustiapicula, new species

Description based on 4 males, 7 females, pinned.

Head: Dorsum of head glossy brownish black except brown bordering eyes; frons below antennal sockets dark brown to brown (two paratypes); rostrum in males reddish brown anteriorly, bright yellowish brown laterally, dark brown in most females; mouthparts dark brown. Antennal scape light brown, brown or reddish brown (holotype), pedicel dark brown, basal flagellomeres dull dark brown, others dull blackish brown; flagellum with 46 segments (paratypes; both antennae broken in holotype).

Thorax: Pronotum blackish brown to black (holotype), bearing many short, dark hairs but usually no bristles along anterior margin (three short bristles at each side in some females). Mesonotal and metanotal scuta blackish brown to black (holotype) with elongate, diffuse, yellowish brown spots at each side, above bases of wings. Mesonotal and metanotal scutella dark brown. Pleura and coxae yellowish brown to reddish brown (holotype). Femora yellowish brown; tibiae brown; tarsi dark brown.



FIGS. 67-71. *Neopanorpa angustiapicula*, new species, structural details. 67, genital bulb, ventral aspect; male holotype. 68, right dististyle, posteromesal (dorsomesal) aspect, to show shape of basal lobe; paratype. 69, abdominal terga 3 and 4, dorsal aspect, showing notal organ; holotype. 70, same as 69, left lateral aspect. 71, terminal abdominal segments, left lateral aspect, holotype. 72, ninth abdominal tergum, dorsal aspect; paratype; most hairs omitted.

oval, notched apically between two rounded lobes bearing long setae (Fig. 79), lightly sclerotized and translucent laterobasally. Genital plate small (compared to that of other species), axial portion ovoid, transparent basally (Fig. 77); arms short, not twisted mesal edges translucent, lateral edges darkened.

Body length: Male, 16.7-18.7 mm (holotype 18.7 mm); female, 10.9-16.6 mm (allotype 16.6 mm). *Length of fore wing:* Male, 12.9-13.1 mm (holotype 13 mm); female, 12.2-13.0 mm (allotype 13 mm).

Holotype: Male, Sumberbrantas, Mt. Ardjuno-Mt. Andjasmoro, East Java, about 1900 m, Jan. 1936, M. E. Walsh. Allotype, female, and 2 ♀ paratypes, same data as for holotype; 3 ♂♂, 3 ♀♀, same data as for holotype except altitude about 2000-2300 m. This species is known from East Java only. Holotype, allotype and most paratypes in the Rijksmuseum van Natuurlijke Historie, Leiden; 1 ♂, 1 ♀ paratypes in the Snow Entomological Museum, The University of Kansas.

Neopanorpa angustiapicula appears closely related to *N. diloba*, forming with it the *angustiapicula* group on the basis of the aedeagal structure. Both species have well developed ventral parameres (absent in most other Indonesian species, except *spicata* and *borneensis*); both have shorter, thicker dorsal parameres than other species; the lateral processes are large and complicated; and both species have large, flattened basal lobes on the dististyles and lack the long, thick, black spines present in the *muelleri* group.

Neopanorpa angustiapicula can be easily distinguished from *diloba* and other species by its reduced wing pattern, generally reddish brown body color, and for males by the elongated process of abdominal tergum 3, the notched process of tergum 4, the long segments 7-8 (more than 1.5 times longer than in other species), the robust genital bulb and the narrowed

tips of the hypovalves, from which the species is named. The female differs from other species in the ovoid axis of the genital plate and in having no apical pale or hairless areas on the subgenital plate.

Neopanorpa diloba, new species

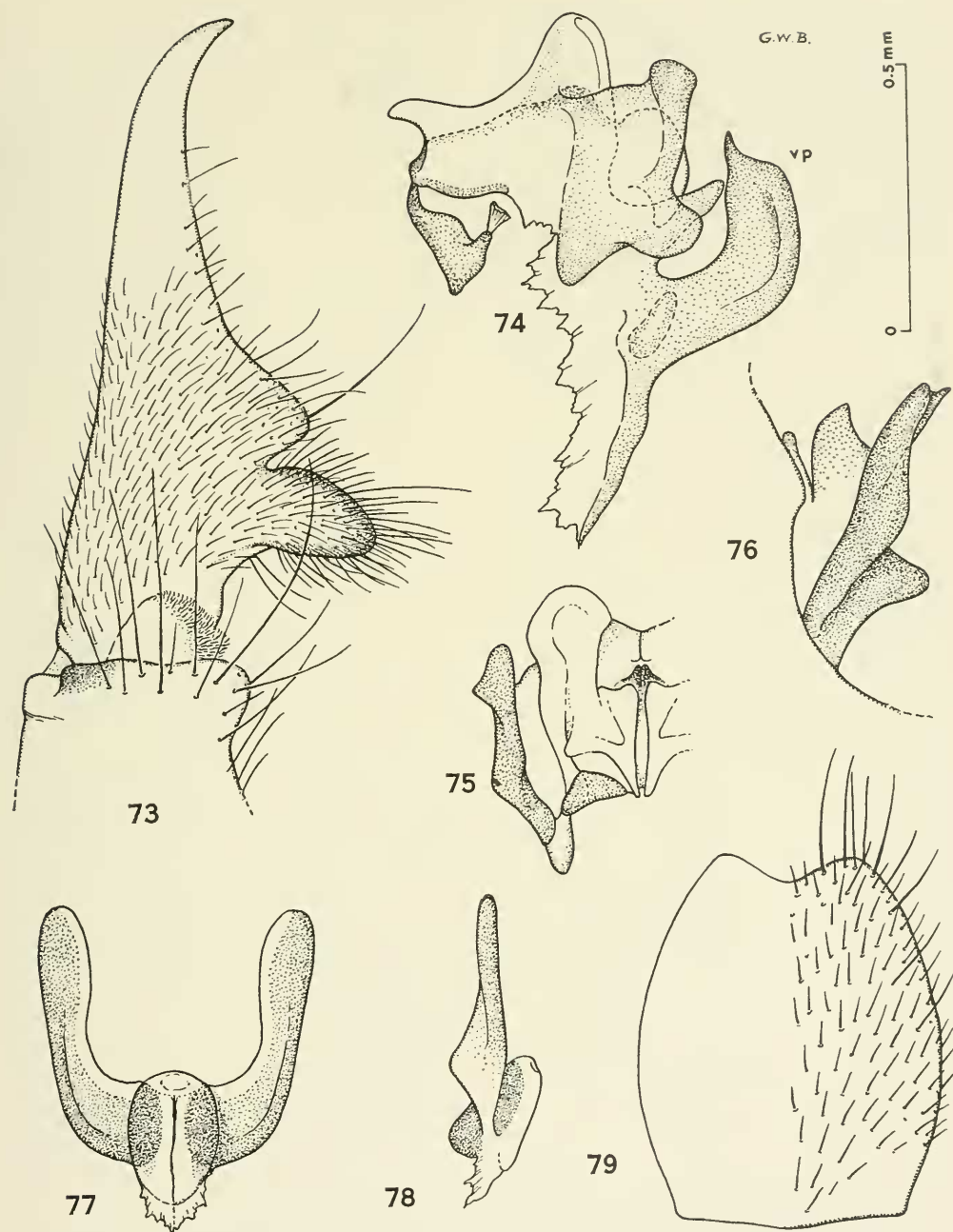
Description based on one callow male, pinned.

Head: Dorsum glossy blackish brown; frons below antennal sockets dark brown; rostrum yellowish brown, change in color between frons and rostrum abrupt; mouthparts brown, tips of palps dark brown. Antennal scape brown, pedicel dark brown, basal flagellomere dull brown, others dull dark brown (both antennae broken).

Thorax: Pronotum brownish black, bearing 4-5 bristles on each side along anterior margin. Mesonotum and metonotum brownish black, with paler areas near wing bases. Pleura and coxae dull brown, covered with short, whitish hair. Femora yellowish brown; tibiae dull brown; basitarsi dull brown, other tarsomeres dark brown.

Wings (Fig. 80): Almost colorless, slightly iridescent, with faint smoky brown markings. Apical band small and incomplete, with detached spots in cell 1st R₃ and cell 2nd R₅. Unforked pterostigmal band slender, faint and incomplete. Marginal spot absent. Basal band reduced to faint, large spot in cell R and smaller one in cell M.

Abdomen of male: Terga 1-4 dark brown; tergum 5 dark brown basally, brown apically. Sterna 2-5 brown. Segment 6 dark brown; segment 7 brown basally, pale yellowish brown apically; segment 8 pale yellowish brown; segment 9 yellowish brown except hypovalves dark brown. Posterior process of tergum 3 stout, extending over about two-thirds length of tergum 4. Hypovalves of sternum 9 darkened, very large, hairless on



FIGS. 73-79. *Neopanorpa angustiapicula*, new species, details of male and female genitalia. 73, left dististyle, ventral aspect; male paratype. 74, aedeagus, left lateral aspect; male paratype; vp—ventral paramere. 75, aedeagus, posteroventral aspect, left half with ventral paramere removed; paratype. 76, left ventral paramere and edge of lateral process, ventral aspect; paratype. 77, genital plate of female, ventral aspect; paratype. 78, same as 77, left lateral aspect. 79, subgenital plate of female, ventral aspect; paratype; hairs partially omitted.

mesal margins (Fig. 81). Ninth tergum (Fig. 84) broad, short, yellowish brown, with slightly rounded apical margin; ventral processes directed anteriorly (Fig. 85). Cerci pale basally, dark brown apically. Genital bulb broad and short; basistyles yellowish brown, dististyles yellowish brown, short and stout, their outer margins generally straight, curved at tips. Basal lobes of dististyles large, darkened, bearing many long hairs, flattened, each subdivided into two lobes, ventral one smaller, pointed, dorsal one larger, bluntly rounded (Figs. 83, 87). Above basal lobe on mesal surface of each dististyle a rounded ridge (Fig. 83) appearing as a blunt, angular projection in ventral aspect (Fig. 87). Aedeagus complicated, lightly sclerotized, yellowish brown, with more densely sclerotized ventral parameres and lateral processes. Ventral valves small, set unusually far dorsally on aedeagus (Figs. 87, 88); dorsal valves minute, concealed between dorsal parameres in lateral aspect and by ventral valves in ventral aspect. Ventral parameres somewhat spatulate, curved ventrad and caudad from ventral surface of aedeagus (Figs. 87, 88); dorsal parameres short, thick, bluntly rounded at apices (Figs. 86, 88). Lateral processes divided, with thick inner lamellae below and before ventral valves (latter subquadrate in outline in Fig. 88) and outer lamellae each bearing a knob-like process, with a deep pocket at each side, a little below ventral valves, separating lamellae (Figs. 87, 88).

Body length: Male, about 14.0 mm.

Length of fore wing: 11.5 mm.

Holotype: Male, southeastern Djambangan, Tengger Mts., East Java, 1800 m, July 1939, N. van Bemmelen-Lieneman.

We consider species to be closely related to *angustiapicula* on the basis of the structure of genitalia, as discussed under *angustiapicula*. Both species are restricted to East Java. *Neopanorpa diloba* can be easily recognized by its faint, almost obliterated wing pattern, its long, wide hypoalve, and the characteristic flattened, divided basal lobes of the dististyles, from which the species is named.

NEOPANORPA FRACTURA Group

Neopanorpa fractura, new species

Description based on 15 males, 18 females, pinned.

Head: Dorsum glossy black; frons below antennal sockets dark brown; rostrum dark brown anteriorly, yellowish brown laterally; mouthparts brown except tips of palps dark brown. Antennal scape yellowish brown, pedicel brown, flagellum dull dark brown on basal segment, otherwise dull blackish brown, with 41 flagellomeres.

Thorax: Pronotum black, bearing about 4-5 bristles on each side at anterior margin. Mesonotum and metanotum blackish brown to black. Pleura and coxae yellowish brown to dingy dark brown (reddish brown in holotype). Femora and tibiae dingy yellowish brown; basitarsi dull brown, other tarsomeres dark brown.

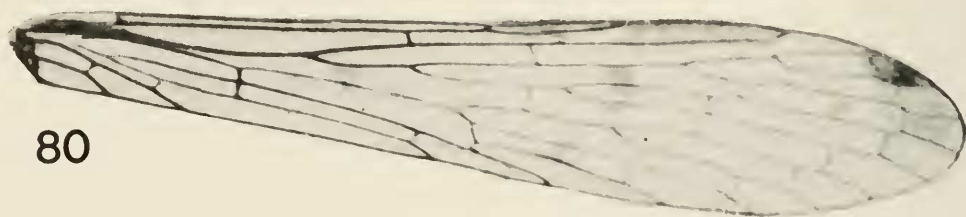
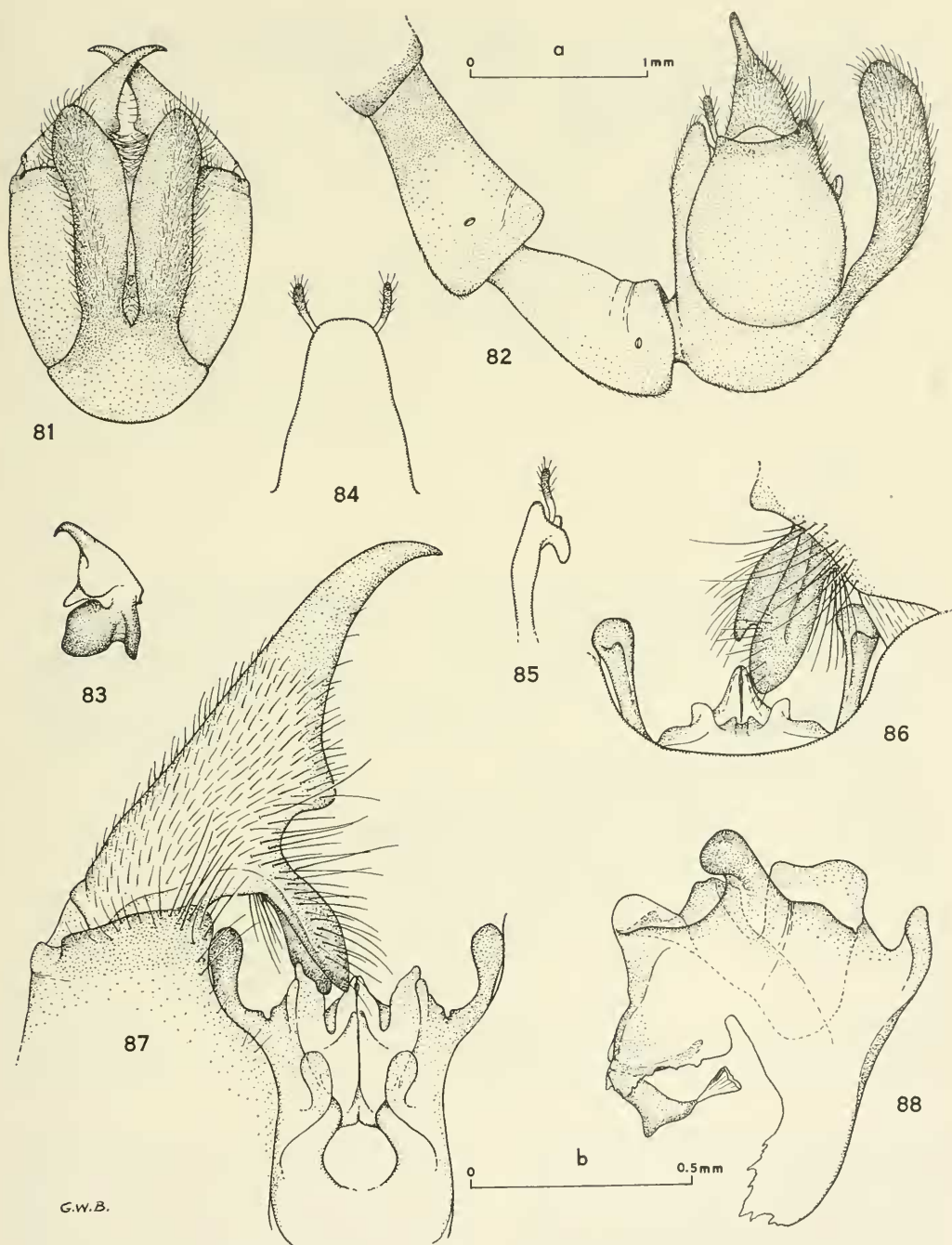
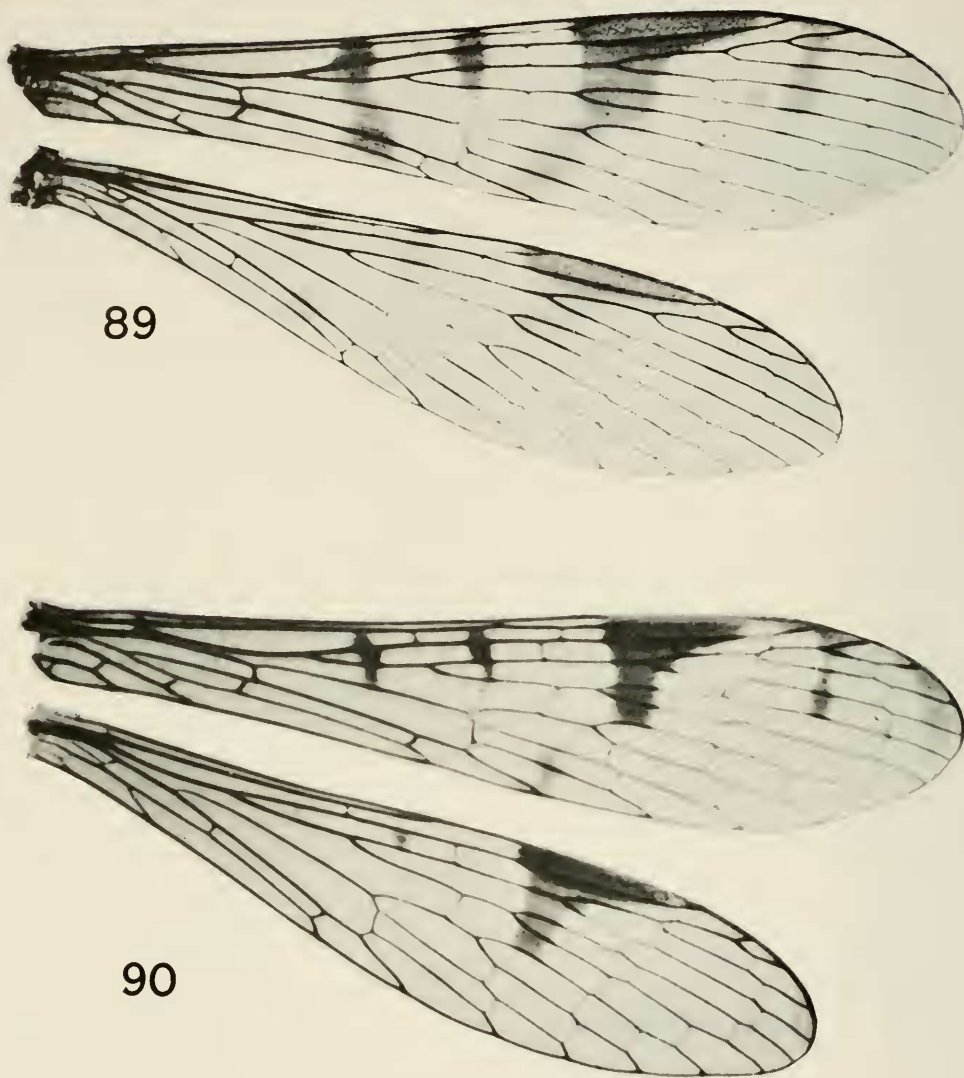


FIG. 80. *Neopanorpa diloba*, new species, right fore wing of male holotype.



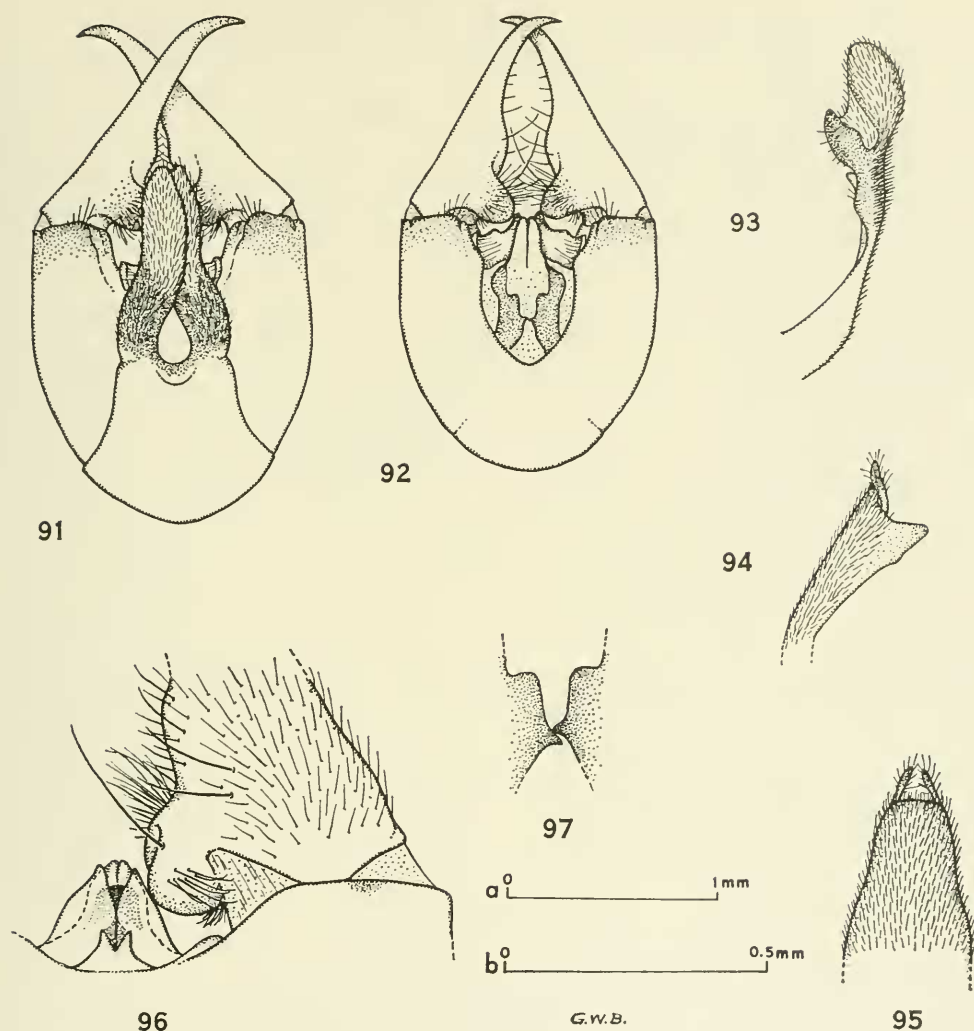
FIGS. 81-88. *Neopanorpa diloba*, new species, structural details of male holotype. 81, genital bulb, ventral aspect. 82, terminal abdominal segments, left lateral aspect. 83, right dististyle, posteromesal (dorsomesal) aspect, to show shape of basal lobe. 84, abdominal tergum 9, dorsal aspect. 85, same as 84, left lateral aspect. 86, basal lobe of left dististyle and aedeagus, dorsal aspect. 87, left dististyle, apex of basistyle, and aedeagus, ventral (posterior) aspect. 88, aedeagus, left lateral aspect. Scale a—Figs. 81-85; scale b—Figs. 86-88.



FIGS. 89-90. *Neopanorpa fractura*, new species, right wings of two male paratypes from north central Sumatra, showing variation in pigmentation.

Wings (Figs. 89, 90): Clear, slightly iridescent, with markings smoky dark brown. In fore wing, apical band fragmented, reduced to brown tinge in distal portion of outermost row of radial cells and transverse spot, variable in extent, at level of distal fork of R_2 . Pterostigmal band variable from complete and forked posteriorly (1 female), to entire but strongly constricted at mid-length and lacking

distal branch (holotype and 10 paratypes), to interrupted at or near M_1 with proximal branch represented by one or two spots near wing margin (in most paratypes). Basal band usually represented by one or two spots, entire in holotype and 6 paratypes. Marginal spot conspicuous, basal spot absent. Hind wing: incomplete pterostigmal band present, weak apical band and marginal spot present in holotype but

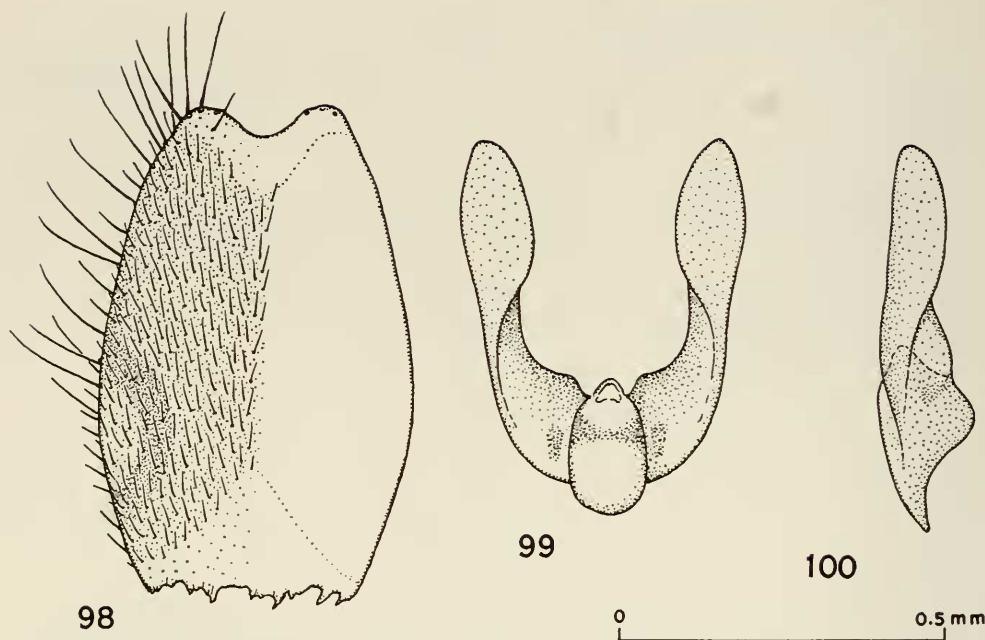


FIGS. 91-97. *Neopanorpa fractura*, new species, structural details of male. 91, genital bulb, ventral aspect; holotype. 92, genital bulb, ventral aspect, with ninth sternum removed to show aedeagus; paratype. 93, hypovalve of ninth sternum, left lateral aspect. 94, ninth abdominal tergum, left lateral aspect. 95, same as 94, dorsal aspect. 96, base of left dististyle and aedeagus, dorsal aspect. 97, supposed rudimentary ventral parameres, ventral aspect. Scale a—Figs. 91-95; scale b—Figs. 96-97.

absent in most paratypes; basal spot present in some specimens.

Abdomen of male: Terga 1-5 usually black; sterna 2-5 yellowish brown. Segment 6 blackish brown. Segments 7-9 yellowish brown. Posterior process of tergum 3 a narrow triangle, widened basally, extending about half-way across tergum 4. Hypovalves glossy dark brown at base to dull brown at tip, bent mesad near mid-

length, with inner margins broadly overlapping, outer margins strongly infolded dorsally, nearly touching inner margins; a stout, dorsal, lightly sclerotized projection near mid-length in lateral aspect (Fig. 93). Tergum 9 (Figs. 94, 95) broadly rounded to nearly truncate apically; ventral process with incurved edge. Basistyles yellowish brown; dististyles dark brown, their outer margins nearly straight except abruptly



FIGS. 98-100. *Neopanorpa fractura*, new species, details of genitalia of female allotype. 98, subgenital plate, ventral aspect; hairs partially omitted. 99, genital plate, ventral aspect. 100, genital plate, right lateral aspect.

curved at tips. Inner basal lobes of dististyles directed anteriorly (downward), bearing long hairs anteroventrally, cleft mesally so that each basal lobe seems divided into two parts (Fig. 96), with a long seta projecting from near cleft, a few (4-8) smaller setae arising from mesodorsal surface of each basal lobe, and tuft of pale hairs beneath basal lobe (Figs. 92, 96). Ventral valves of aedeagus extend a little beyond dorsal valves; lateral processes simple, concave ventromesally; ventral parameres absent or possibly represented by moderately sclerotized bands on ventral surface of aedeagus, bearing small, mesally directed points (Figs. 92, 97). Dorsal parameres conspicuous, thin, translucent, broad and outwardly curved at base, mucronate at apex, each with a small flattened dorsal appendage projecting dorsad with outwardly deflected tip (Fig. 96).

Abdomen of female: Terga 1-6 black; sterna 2-5 pale yellowish brown, sternum 6 dark brown. Segments 7-10

brown. Cerci black. Subgenital plate (Fig. 98) yellowish brown, pale at apex and base, with indistinct, dark-bordered pale spot at margin near base, narrowed gradually from near mid-length, notched apically, bearing many long setae along lateral margins and each side of notch. Axial portion of genital plate ovoid; arms broad, twisted basally (Fig. 99).

Body length: Male, about 11-13 mm (holotype 13 mm); female, about 8-11 mm (allotype 9 mm). *Length of fore wing:* Male, 12-13 mm (holotype 13.2 mm); female, 12.0-13.2 mm (allotype 12 mm).

Holotype: Male, Brastagi, northern central Sumatra, 1400 m, Nov. 1950, M. A. Lieftinck. Allotype and 14 ♂, 17 ♀ paratypes, same data as for holotype. Holotype, allotype and most paratypes in the Rijksmuseum van Natuurlijke Historie, Leiden; 2 ♂, 2 ♀ paratypes in the Snow Entomological Museum, The University of Kansas.

This species with *sumatrana* and *crinita* form the *fractura* group because of the structure of the hypovalves (lightly sclerotized projection on dorsal surface), cleft basal lobes of the dististyles, and structure of the aedeagus of males and genital plates of females. It can easily be recognized by its incomplete apical band, strongly constricted or interrupted pterostigmal band, and the sclerotized projections of the hypovalves. The species is named from the divided appearance of the hypovalves (Fig. 93). It differs from *crinita* in not having long dorsal hairs on the hypovalves, in the shape of the hypovalves (Fig. 93) and the more rounded apex of the 9th tergum. It can be distinguished from *sumatrana* by the more complete wing markings and less prominent dorsal projections on the hypovalves in that species. Females can be distinguished from those of *sumatrana* by the wing pattern. Further differences are found in the subgenital plate and genital plate, which in *sumatrana* has distinct lateral lobes (compare Figs. 99, 124).

Neopanorpa crinita, new species

Description based on 6 males, 1 female, pinned.

Head: Dorsum shining black; frons below antennal sockets dark brown; rostrum dark brown anteriorly, yellowish brown laterally; mouthparts brown except tips of palps dark brown. Antennal scape yellowish brown, pedicel brown, flagellum dull dark brown at base, grading into dull blackish brown, with 40-41 flagellomeres (right flagellum broken in holotype).

Thorax: Pronotum black, bearing 3-5 bristles on each side along anterior margin. Mesonotum and metanotum blackish brown to black. Pleura dark brown to blackish brown near wing bases, yellowish brown to reddish brown near coxae, or discolored to completely dark brown (holotype and 1 male paratype) to black (allotype). Coxae yellowish brown (holotype) to dull brown, blackish brown in allotype. Femora yellowish brown (holotype and most paratypes) to dull dark brown (allotype); tibiae and tarsi brown.

Wings (Fig. 101): Almost colorless,

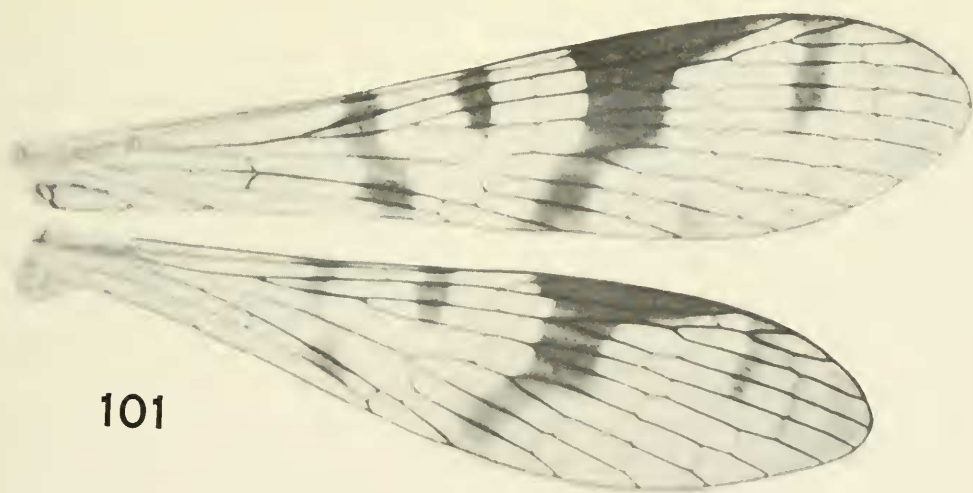


FIG. 101. *Neopanorpa crinita*, new species, right wings of male paratype.

slightly iridescent, with dark smoky brown bands and spots. Apical band very weak, almost obliterated (holotype and 1 male paratype), or fragmented, reduced to brown tinge in distal portion of outermost row of radial cells and transverse spot, variable in extent, at level of distal fork of R_2 and terminating before vein R_5 . Pterostigmal band variable, entire but lacking distal branch in holotype and 3 paratypes; distal branch reduced to a diffuse spot in 2 paratypes. Marginal spot present. Basal band usually entire, broken into two spots in 1 paratype. Basal spot absent or only faintly developed.

Abdomen of male: Terga 1-5 blackish brown to black (holotype); sterna 2-5 yellowish brown to sordid dark brown (holotype). Segment 6 blackish brown. Segments 7-9 brown, dark brown apically on segment 7. Posterior process of tergum 3 narrowly triangular, extending about half-way across tergum 4. Hypovalues dark brown at base to brown at tip, notched laterally and appearing bent near mid-length, with slight process on mesal margin near base (Fig. 103); inner margins overlapped mesally, outer margins strongly infolded dorsally, bearing long, crinkled hairs (except possibly broken off in 1 paratype), and a stout, dorsal, moderately sclerotized projection near mid-length in lateral aspect (Fig. 104). Tergum 9 slightly emarginate (Fig. 105) to nearly truncate apically, its ventral processes subrectangular. Basistyles yellowish brown to brown mesally; dististyles dark brown. Basal lobes of dististyles (Figs. 102, 108) directed anteriorly, bearing long hairs on ventral surface and tuft of shorter hairs anteroventrally, shallowly cleft mesally so that each basal lobe seems divided into two parts; a long seta projecting from near cleft, about 4 smaller spines arising from mesodorsal surface of each basal lobe. Ventral valves of aedeagus extending ventrad, somewhat hooked (Fig. 107); lateral

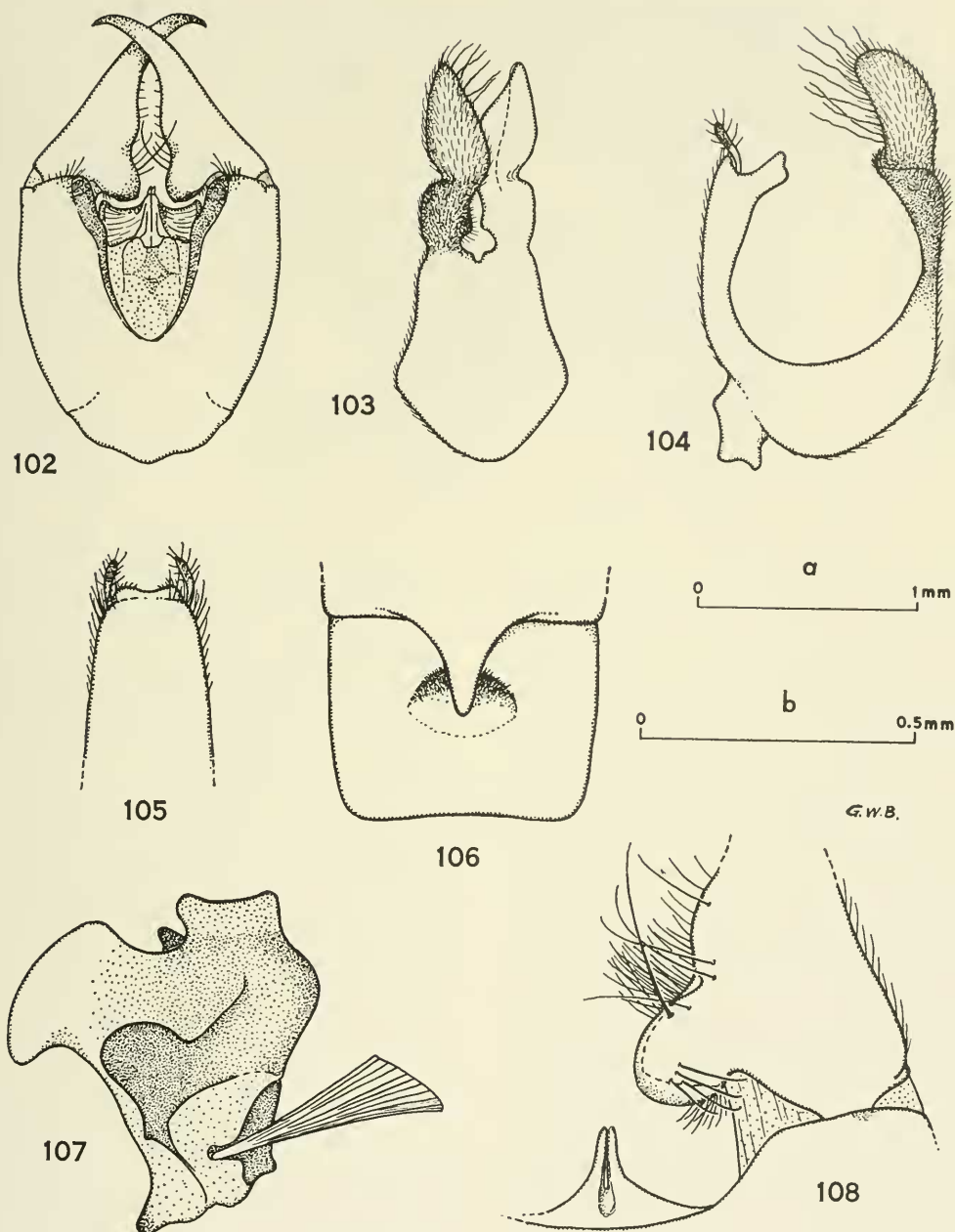
processes simple, concave; ventral parameres absent; dorsal parameres thin, subquadrate blades, closely appressed in dorsal aspect (Figs. 107, 108).

Abdomen of female: Terga 1-6 black; sterna 2-6 sordid brown. Terga 7-9 blackish brown, corresponding sterna dark brown. Cerci blackish brown. Subgenital plate yellowish brown, pale and notched apically, with 5-6 setae on lobe at each side of notch, pale apical area otherwise hairless; low folds from antero basal corners converging medially, area between folds pale, without hairs (Fig. 109). Axial portion of genital plate broadly subconical with darkly sclerotized, rounded lateral lobe at each side above base of distal arm; arms moderately sclerotized, twisted basally (Fig. 110).

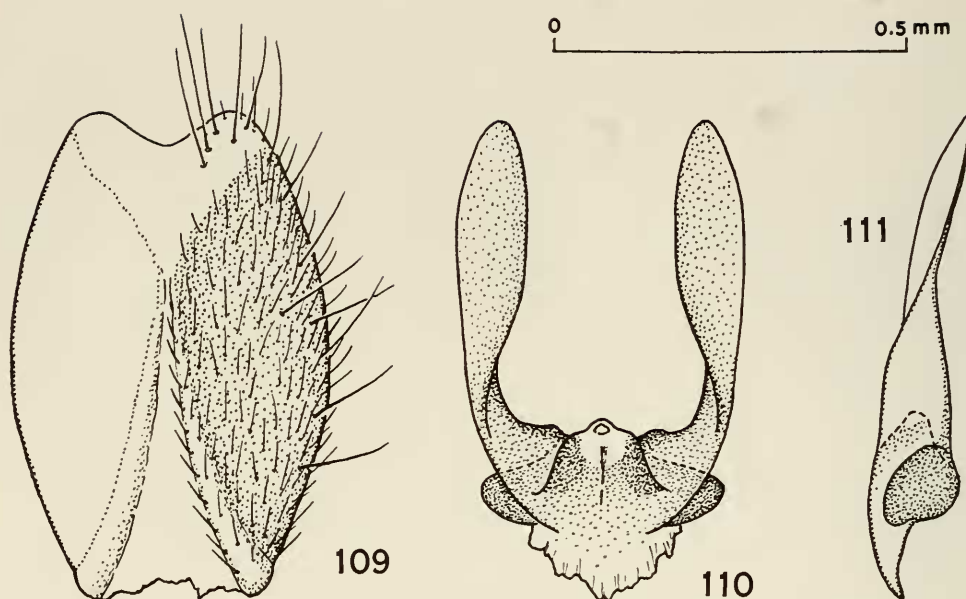
Body length: Male, about 12-14 mm (holotype 14 mm); female (allotype) about 9 mm. *Length of fore wing:* Male, 12-14 mm (holotype 13 mm); female (allotype), 12.3 mm.

Holotype: Male, Suban Ajam, Sumatra, July 1916, Jacobson. Allotype, same data as for holotype. One ♂ paratype, Giesting, Mt. Tanggamus, southwestern Lampongs, southern Sumatra, 800 m, 27 Dec. 1934, Lieftinck; 1 ♂, Wai Tebu, Mt. Tanggamus, southern Sumatra, 500 m, 24 June 1934, Toxopeus; 1 ♂, Mt. Tanggamus, 1000 m, 12 July 1934, Toxopeus; 1 ♂, Air Njuru, Dampu, Sumatra, 1400 m, Aug. 1916, Jacobson; 1 ♂, Muara Sako, Sumatra, Oct. 1915, Jacobson. Holotype, allotype and 3 ♂ paratypes in the Rijksmuseum van Natuurlijke Historie, Leiden; 2 ♂ paratypes in the Snow Entomological Museum, The University of Kansas.

N. crinita is very similar to *N. fractura*, but the two have quite different ranges. *N. crinita* may be distinguished from *fractura* and *sumatrana* by the long, crinkled hairs on the hypovalues, from which the species is named, and by the more abruptly bent shape of the hypovalues (cf. Figs. 91,



FIGS. 102-108. *Neopanorpa crinita*, new species, structural details of male paratype. 102, genital bulb, ventral aspect, with ninth sternum removed to show aedeagus. 103, ninth abdominal sternum and hypovalves, ventral aspect, only partly shaded to show color pattern. 104, ninth abdominal tergum and sternum, left lateral aspect; most hairs omitted. 105, ninth abdominal tergum, dorsal aspect; most hairs omitted. 106, abdominal terga 3 and 4, dorsal aspect, showing notal organ. 107, aedeagus, right lateral aspect. 108, base of left dististype and dorsal parameres, dorsal aspect. Scale a—Figs. 102-106; scale b—Figs. 107-108.



FIGS. 109-111. *Neopanorpa crinita*, new species, details of genitalia of female allotype. 109, subgenital plate, ventral aspect; hairs partially omitted. 110, genital plate, ventral aspect. 111, genital plate, right lateral aspect.

103) and less conspicuous sclerotized projection on the dorsal surface of each hypovalve (Figs. 93, 104). It can be further differentiated from *fractura* by its longer ventral valves, the thin, subrectangular dorsal parameres (more outwardly rounded in *fractura*) and the more complete pterostigmal band, especially the proximal branch. The thin, appressed dorsal parameres and the simpler wing pattern separate this species from *sumatrana*. In the female, the pale mesal zone and bordering folds of the subgenital plate and the darkened lateral lobes of the axial portion of the genital plate confirm the identification suggested by the wing patterns and together differentiate *crinita* from *fractura* and *sumatrana*.

Neopanorpa sumatrana, new species

Description based on 1 male, 4 females, pinned.

Head: Dorsum glossy black; frons below antennal sockets blackish brown; rostrum grayish brown basally, reddish brown apically, except yellowish brown

along sides; mouthparts brown, dark brown at apex of palps. Antennal scape brown, pedicel dark brown, flagellum dull dark brown, with 41 segments (left flagellum broken on holotype).

Thorax: Pronotum black, bearing 4 bristles on each side along anterior margin. Mesonotum and metanotum black. Pleura mostly dull blackish brown, brown near coxae. Coxae and femora dull brown; tibiae and tarsi dull dark brown.

Wings (Fig. 112): Membrane colorless and slightly iridescent, bands and spots dark smoky brown. Apical band including small posterior pale spot in holotype and most paratypes. Pterostigmal band complete, forked posteriorly, joining apical band narrowly along costal margin, distal branch smaller than proximal branch. Marginal spot conspicuous. Basal band complete. Basal spot absent in holotype and most paratypes.

Abdomen of male: Terga 1-5 blackish brown, corresponding sterna yellowish brown. Segment 6 blackish brown, segments 7-9 reddish brown except hypovalves

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FIG. 112. *Neopanorpa sumatrana*, new species, right wings of female paratype.

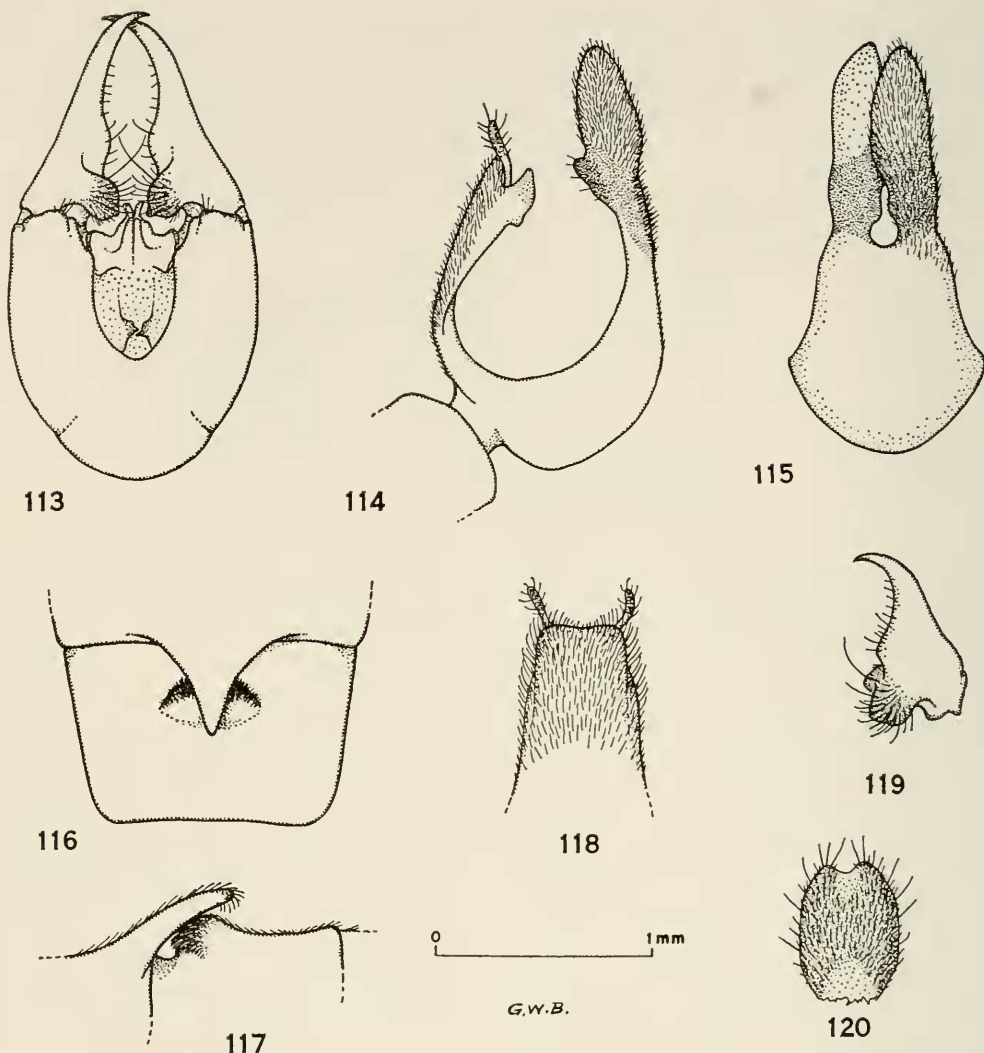
of sternum 9 darker. Posterior process of tergum 3 triangular, extending about half-way across tergum 4 (Fig. 116). Hypovalves of sternum 9 dark brown at base to brown at tip, inner margins overlapped mesally, outer margins strongly infolded dorsally; near mid-length on dorsal surface, a stout, sclerotized projection (Fig. 114). Tergum 9 (Fig. 118) brown, truncate apically. Basistyles short, slightly longer than dististyles; dististyles long, their outer margins slightly concave before mid-length (Fig. 113). Basal lobes of dististyles (Fig. 123) directed downward (anteromesad), bearing long ventral hairs, cleft (Fig. 119) so as to form two parts; a long seta projecting from near cleft; about 7-10 smaller apically curved spines projecting from mesodorsal surface of each basal lobe (Figs. 119, 121); tuft of pale hairs in notch between basal lobe and base of dististyle. Ventral valves of aedeagus extend well beyond small dorsal valves; lateral processes simply concave, ventral parameres absent or possibly represented by small, moderately sclerotized points on anteroventral surface of aedeagus; dorsal parameres large, outwardly convex blades, appressed basally but with dorsal margins divergent (Fig. 121), more ventral mar-

gins curved outwardly around dorsal valves (Fig. 122).

Abdomen of female: Terga 1-6 black; sterna 2-5 yellowish brown, sternum 6 dark brown. Terga 7-9 blackish brown, corresponding sterna brown. Segment 10 and cerci black. Subgenital plate yellowish brown with whitish, notched apex, bearing many long setae along lateral margins and at each side of notch (Fig. 120). Axial portion of genital plate ovoid, with conspicuous, rounded lobe at each side; arms of distal portion broad, twisted basally, with outer margins pale (Fig. 124).

Body length: Male, about 10 mm (holotype); female, about 8-10 mm (allotype 9 mm). *Length of fore wing:* Male, 12.7 mm (holotype); female, 12.1-13.5 mm (allotype 13.5 mm).

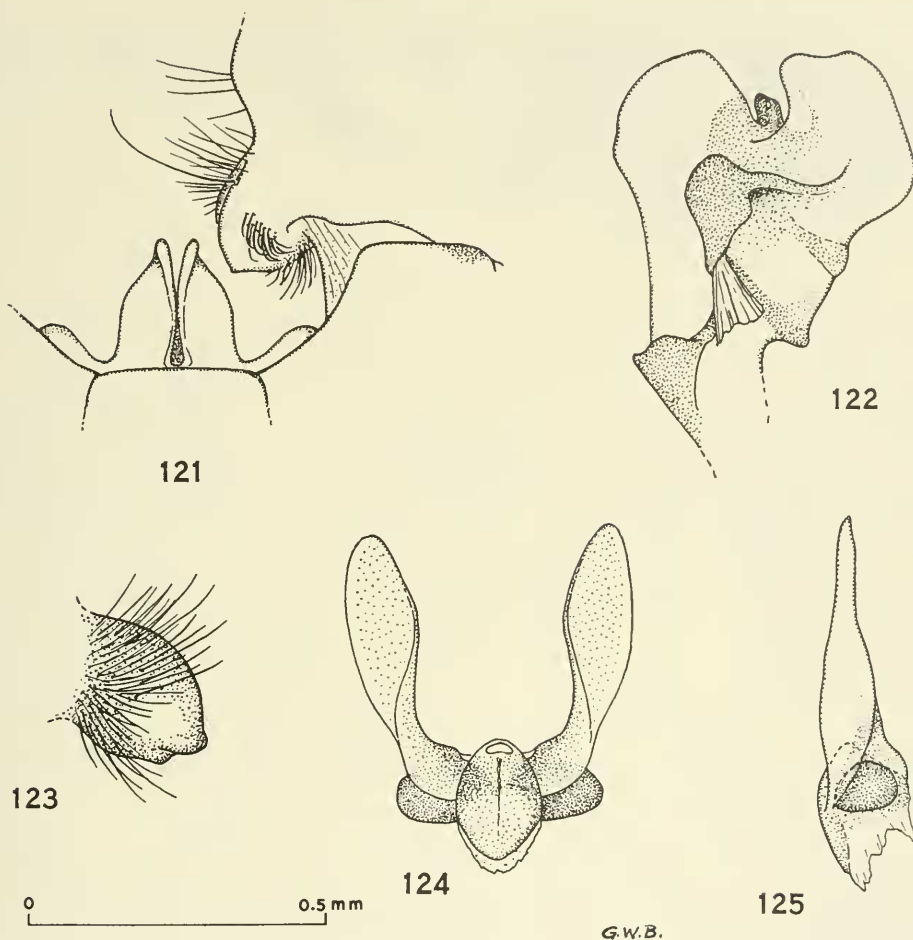
Holotype: Male, Fort de Kock (Bukittinggi), Sumatra, 920 m, 1924, Jacobson. Allotype, Tandjungadang, near west coast of Sumatra, 1200 m, Feb. 1926, Jacobson. Paratypes: 1 ♀, same data as for holotype; 2 ♀ ♀, same data as for allotype, except 1000 m. Holotype, allotype and 2 ♀ paratypes in the Rijksmuseum van Natuurlijke Historie, Leiden; 1 ♀ paratype in the Snow Entomological Museum, The University of Kansas.



FIGS. 113-120. *Neopanorpa sumatrana*, new species, structural details of male holotype and female paratype. 113, genital bulb, ventral aspect, ninth sternum removed to show aedeagus. 114, ninth abdominal tergum and sternum, left lateral aspect. 115, ninth sternum and hypovalves, ventral aspect. 116, abdominal terga 3 and 4, dorsal aspect, showing notal organ. 117, same as 116, left lateral aspect. 118, ninth tergum, dorsal aspect. 119, right dististyle, posteroventral (slightly posteromesal) aspect, to show shape of basal lobe. 120, subgenital plate of female, ventral aspect.

We place this species in the *fractura* group because of the structure of the hypovalves, basal lobes of the dististyles, and aedeagus in the male and of the genital plate in the female. It may be distinguished from *fractura* by its complete, extensive wing markings, both in male and female, less protruding dorsal projec-

tion of the hypovalves, and the very characteristic, dorsal parameres, of which the dorsal part is much larger in *sumatrana* than that in *fractura*. The female is differentiated from that of *fractura* by the subgenital plate (narrowed more abruptly in *sumatrana*) and by the conspicuous lateral lobes of the genital plate.



FIGS. 121-125. *Neopanorpa sumatrana*, new species, details of genitalia of male holotype and female paratype. 121, basal lobe of left dististyle and dorsal parameres, dorsal aspect. 122, aedeagus, right lateral aspect. 123, basal lobe of left dististyle, ventral aspect. 124, genital plate of female, ventral aspect. 125, same as 124, right lateral aspect.

NEOPANORPA BORNEENSIS Group

Neopanorpa borneensis Byers, 1966

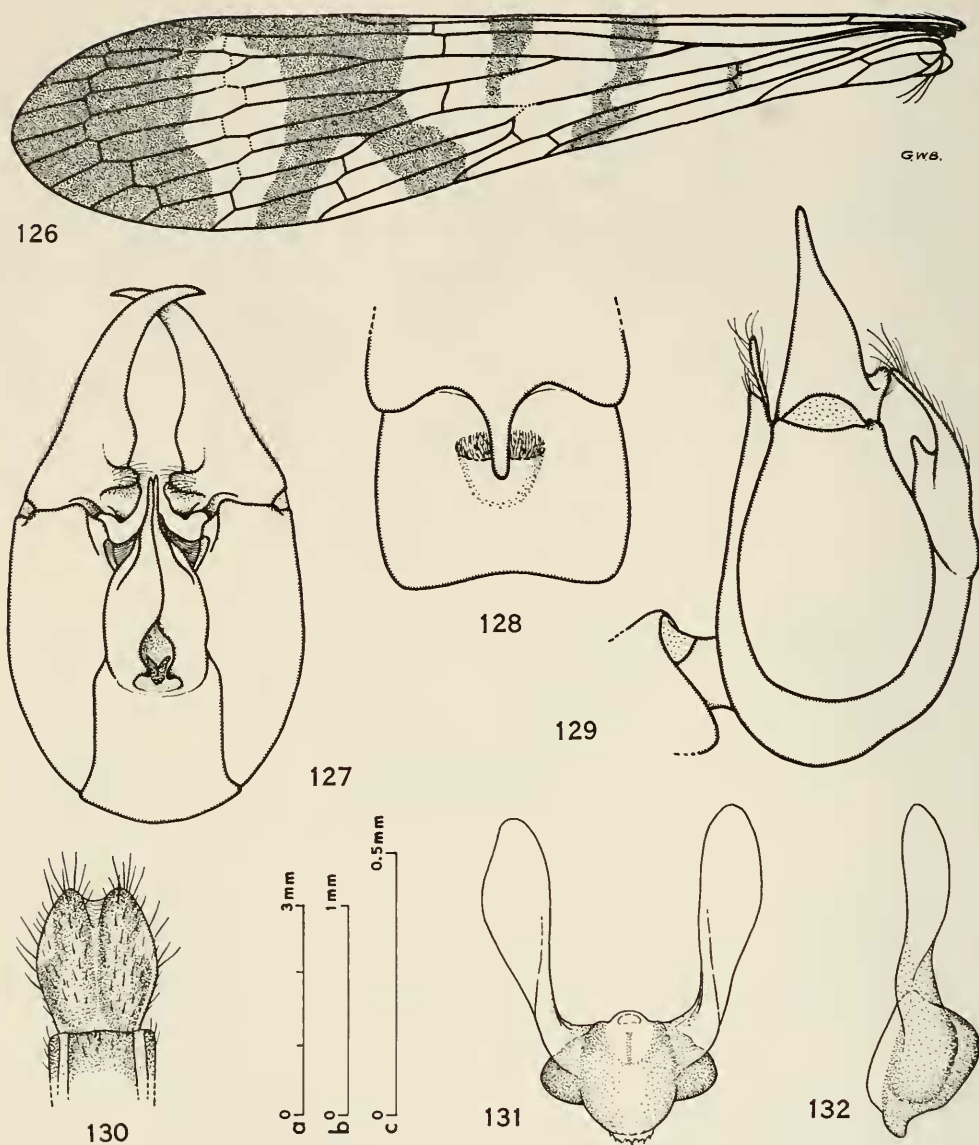
Description mostly based upon original description (Byers, 1966), based on 2 males and 6 females, pinned.

Head: Dorsum glossy black; frons below antennal sockets dark brown; genae light yellowish brown; rostrum dark brown anteriorly, yellowish brown laterally, especially near base, except for thin line of brown along edge of eye; margin of labrum black. Antennal scape dark yellowish brown, pedicel brown; flagellum

dark brown basally, grading into black, with 41 flagellomeres.

Thorax: Pronotum black, with 3 bristles at each side on anterior margin. Mesonotum and metanotum almost wholly black, each with small, poorly defined, yellowish brown areas on posterolateral shoulders of scutum near wing bases. Pleura and coxae dark yellowish brown. Femora yellowish brown; tibiae darker yellowish brown; tarsi brown, darkest apically.

Wings (Fig. 126): Almost colorless, marked with bands and spots of dark



FIGS. 126-132. *Neopanorpa borneensis* Byers, structural details of male holotype and female allotype. 126, left fore wing of male. 127, genital bulb, ventral aspect. 128, abdominal terga 3 and 4, dorsal aspect, showing notal organ. 129, genital bulb, left lateral aspect. 130, subgenital plate of female, ventral aspect. 131, genital plate, ventral aspect. 132, same as 131, right lateral aspect. Scale a—Fig. 126; scale b—Figs. 127-130; scale c—Figs. 131-132.

near species has been discussed by Byers (1966).

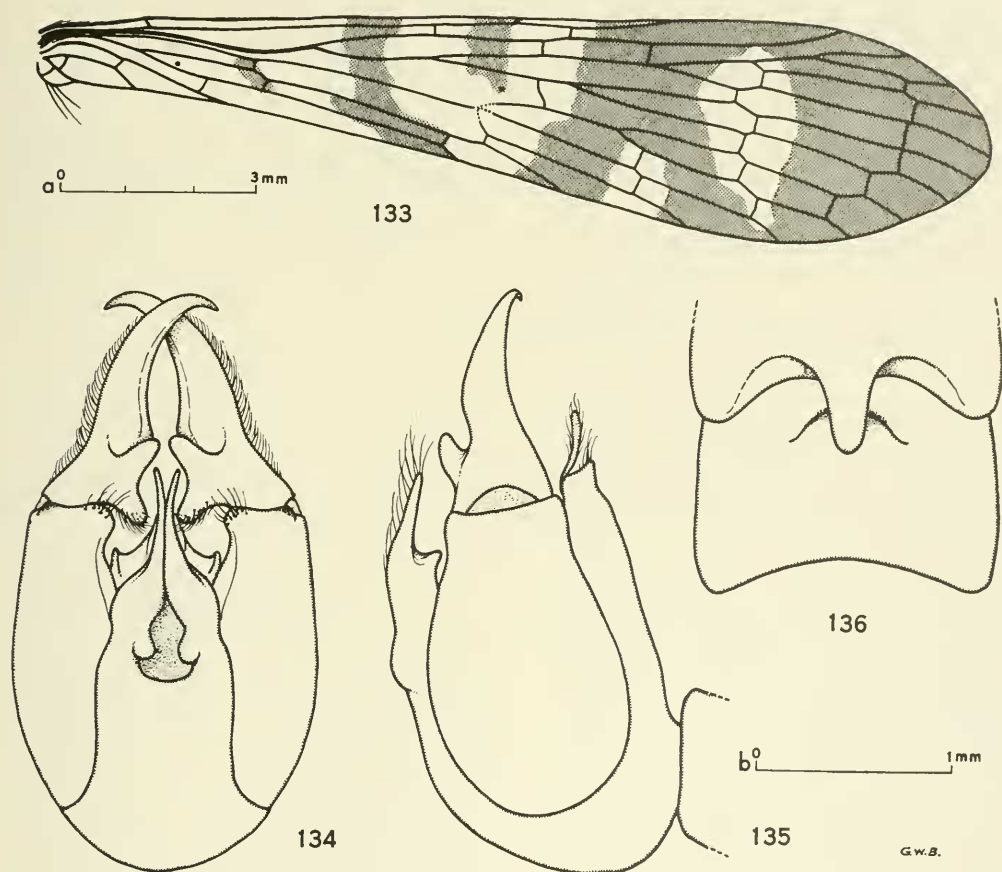
Neopanorpa flavicauda Banks, 1931

Description modified from Banks (1931b) and Byers (1966).

Rostrum pale laterally. Antennal scape

pale; left and half of right flagella lacking in lectotype. Legs yellowish brown.

Wings (Fig. 133): Clear, bands and spots almost black. Apical band complete. Pterostigmal band complete, broadly joined to apical band along costal margin, forked posteriorly, with distal branch as



FIGS. 133-136. *Neopanorpa flavicauda* Banks, structural details of male paralectotype. 133, right fore wing. 134, genital bulb, ventral (posterior) aspect. 135, genital bulb, right lateral aspect. 136, abdominal terga 3 and 4, dorsal aspect, showing notal organ. Scale a—Fig. 133; scale b—Figs. 134-136.

broad as proximal branch; distal branch joined to apical band at margin in some specimens (not in lectotype). Marginal spot conspicuous. Basal band entire, slightly spurred proximad between veins Cu_1 and Cu_2 . A small basal spot near mid-width of wing before basal band in most specimens.

Abdomen of male: Segments 7-9 pale yellowish brown. Segment 6 cylindrical and plainly longer than 5th; segments 7-8 shorter than 6th, 7th longer than 8th. Posterior process of tergum 3 linguiform in some males (Fig. 136), longer and more slender in lectotype than in male illustrated here. Dististyles thick, their outer

margins markedly concave in basal half, abruptly curved at tips. Basal lobes of dististyles conspicuously divided into proximal and distal protuberances, distal one slightly the larger. Hypovalues of sternum 9 expanded basally, attenuate apically (Fig. 134), with a rounded basal lobe on mesal margin and a blunt dorsolateral projection near mid-length (Fig. 135). Aedeagus not examined.

Females have not been examined.

Lectotype: Male, Kenokok, Mt. Kinabalu, Sabah (British North Borneo), 1100 m, 26 April 1929, in the British Museum (Nat. Hist.), London. Paralectotypes: 4 ♂♂, 4 ♀♀, same data as for

smoky brown. Apical band entire, somewhat faded posteriorly in both males, with included pale spot posteriorly in two females. Pterostigmal band entire, forked posteriorly, connected along costal margin to apical band. Cross-veins in area between apical and pterostigmal bands pale. Marginal spot extending from costa to M_{1+2} or farther. Basal band entire, strongly constricted near mid-length in male, not in female. Small basal spot present over cross-veins 1st m-cu and 1st cu.

Abdomen of male: Terga 1-4 black, tergum 5 dark brown; corresponding sterna sordid yellowish brown mottled with brown. Segment 6 dark brown with yellowish brown apex; segments 7-8 yellowish brown; segment 9 dark yellowish brown, except tips of dististyles brown. Posterior process of tergum 3 slender, parallel-sided in apical half, extending about half-way across tergum 4 (Fig. 128). Prominence on tergum 4 rounded and smooth posteriorly, flattened and hairy anteriorly. Hypovalues dark yellow-brown, darkened apically, widened near mid-length, acuminate in apical half and bearing a few long hairs near apex, each with a stout, strongly sclerotized dorsolateral projection (Figs. 127, 129). Tergum 9 evenly tapered toward apex, with truncate apical margin. Dististyles stout, outer margins slightly concave near base, darkly sclerotized beyond mid-length. Basal lobes of dististyles comprising an elongate, hairy, ventral (posterior) projection and a more dorsal, thickened, less hairy portion sclerotized on lower, mesal margin (Fig. 127). Ventral valves of aedeagus sclerotized, rounded in lateral aspect, not projecting between hypovalues; bases of ventral parameres in form of narrow, acutely tipped blades projecting backward (ventrad) (shown as shaded V-shaped structure between bases of hypovalues, in Fig. 127).

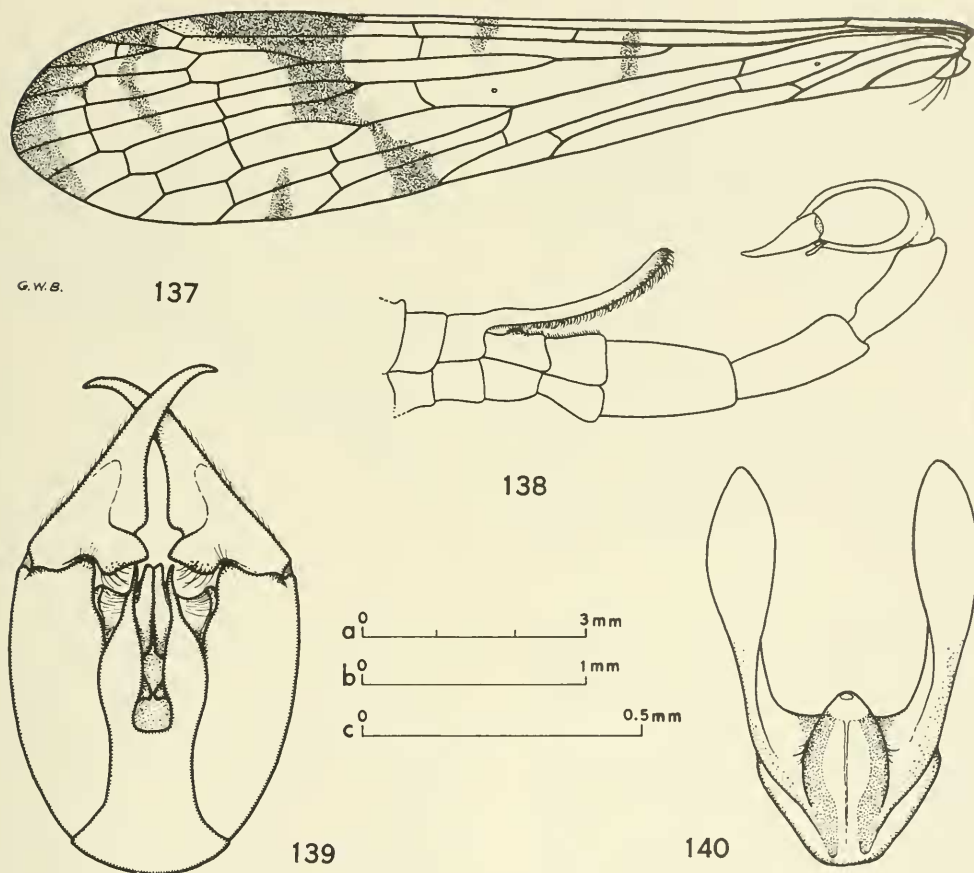
Abdomen of female: All terga brownish black, sterna mottled, sordid

brown; cerci black. Subgenital plate of sternum 8 broadly and shallowly notched at apex, with long setae on each apical lobe and on lateral margins of plate; pigmentation of plate in definite bilateral pattern with pale median streak (Fig. 130). Axial portion of genital plate broadly oval, flanked by wide, rounded, dorsoventrally thickened lateral lobes (Figs. 131, 132); arms of plate broadly spatulate, slightly twisted basally.

Body length: Male, about 12-13 mm (holotype 13 mm); female, about 10-14 mm (allotype 14 mm). *Length of fore wing:* Male, 13.6-14.4 mm (holotype 13.6 mm); female, 13.8-14.8 mm (allotype 14.6 mm).

Holotype: Male, Tenompok, 48 km E of Jesselton, Sabah (British North Borneo), 1460 m, 26-31 Jan. 1959, T. C. Maa. Allotype, female, Keningau, Sabah (British North Borneo), 12-17 Jan. 1959, T. C. Maa. Paratypes: 1 ♂, 5 ♀♀, Bundu Tukan, Sabah (British North Borneo), 18 Feb. 1959, T. C. Maa. Holotype, allotype and 4 paratypes in collection of the Bernice P. Bishop Museum, Honolulu, Hawaii; 1 ♂, 1 ♀ paratypes in Snow Entomological Museum, The University of Kansas. A male lacking abdominal segments beyond the 6th, from Kiam Base, north of Mt. Kinabalu, 4 Feb. 1959, was not made a paratype.

The three known Bornean species, *flavicauda*, *spicata* and *borneensis*, are easily differentiated from the Javanese and Sumatran species by the longer abdominal segments 7-8, the shapes of the acuminate-tipped hypovalues and aedeagus of the male, characters which also show the close relationship among them. The axial portion of the genital plate of Bornean species is usually rounded, as in species of the *fractura* group, and the lateral lobes of genital plate are much larger and more conspicuous, if present. The supposed relationship among these Bor-



FIGS. 137-140. *Neopanorpa spicata* Byers, structural details of male holotype and female allotype. 137, left fore wing, male. 138, abdomen of male, left lateral aspect, showing elongate posterior process of tergum 3 (notal organ). 139, genital bulb of male, ventral aspect. 140, genital plate of female, ventral aspect. Scale a—FIGS. 137-138; scale b—FIG. 139; scale c—FIG. 140.

lectotype, except 22, 23 and 26 April 1929, in the British Museum; 1 ♂, in the University Zoological Museum, Copenhagen; 2 ♂♂, 2 ♀♀ and 1 ♂ not labelled as a type but with the same data as the lectotype, in the Museum of Comparative Zoology, Harvard University.

For the probable relationships of this species, see under *N. borneensis*.

Neopanorpa spicata Byers, 1966

Description mostly repeated from original description (Byers, 1966), based on 11 males and 4 females.

Head: Dorsum glossy black; frons below antennal sockets dark brown; ros-

trum brown anteriorly, yellowish brown laterally; mouthparts yellowish brown. Antennal scape yellowish brown, pedicel brown; flagellum (both incomplete in holotype) black, with 40 to 42 flagellomeres.

Thorax: Pronotum black, with 4 or 5 bristles at each side on anterior margin. Mesonotum and metanotum mostly dark brownish black, each with poorly defined, pale yellowish brown areas on posterolateral shoulders of scutum near wing bases. Pleura and coxae sordid yellowish brown. Femora, tibiae and basitarsi sordid yellowish brown, apical tarsomeres brown.

Wings (Fig. 137): Mostly clear, slightly iridescent, with bands and spots

smoky brown. Apical band in fore wings weakly indicated along margin in holotype, allotype and 7 paratypes, broader but deeply indented or including variously shaped clear areas in other paratypes. Pterostigmal band complete, constricted and almost broken near mid-length, forked posteriorly in some specimens. Marginal spot small, basal band short, not darkly colored (holotype) to complete but slender. A small basal spot in cell 1st Cu₁ in one paratype.

Abdomen of male: Terga 1-3 dark brown, terga 4-5 dark yellowish brown; sterna 2-5 dark yellowish brown. Segment 6 yellowish brown, segments 7-8 pale yellowish brown, segment 9 dark yellowish brown. Posterior process of tergum 3 long, stout, curved upward, densely set with black hairs especially on underside, extending to or slightly past mid-length of segment 6 (Fig. 138). Hypovalves of sternum 9 not darkened, separated throughout their length with small mesal lobe near base, widened near mid-length and tapered to acuminate tips (Fig. 139). Tergum 9 slightly narrowed toward truncate apex, with subapical ventral process on each side bent around segment 10. Dististyles long, slender, outer margins nearly straight except curved at tips. Basal lobes of dististyles strongly sclerotized mesally, shallowly excavated below. Ventral valves of aedeagus sclerotized, projecting posteriorly and ventrally (backward) between hypovalves; bases of ventral parameres in form of narrow, blunt-tipped blades projecting backward.

Abdomen of female: Terga 1-4 and about basal half of 5 brownish black; corresponding sterna pale yellowish brown; segments 6-10 dark yellowish brown; cerci black. Subgenital plate of sternum 8 apically notched with 2 thick, finger-like lobes above gonopore on dorsal surface. Axis of genital plate ovoid; genital plate without conspicuous lateral lobes (Fig. 140);

arms of plate spatulate, somewhat twisted near base.

Body length: Male, about 11-13 mm (holotype 12 mm); female, about 9-11 mm (allotype 10 mm). *Length of fore wing:* Male, 12.2-13.2 mm (holotype 13.2 mm); female, 13.1-13.6 mm (allotype 13.6 mm).

Holotype: Male, Tenompok, 48 km E of Jesselton, Sabah (British North Borneo), 1460 m, 17-21 Oct. 1958, T. C. Maa. Allotype, female, same data as for holotype. Paratopotypes: 2 ♀♀, 17-21 Oct. 1958, L. W. Quate; 2 ♂♂, 20 Oct. 1958, L. W. Quate; 3 ♂♂, 1 ♀, 26-31 Jan. 1959, T. C. Maa. One additional ♂ paratype, Singkor, Sabah (British North Borneo), 19 Jan. 1959, Maa. The holotype is pinned together with a small ichneumonid wasp on which it was feeding at the time of capture. Holotype, allotype and 10 paratypes in the Bernice P. Bishop Museum, Honolulu, Hawaii; 2 ♂♂ and 1 ♀ paratypes in the Snow Entomological Museum, The University of Kansas.

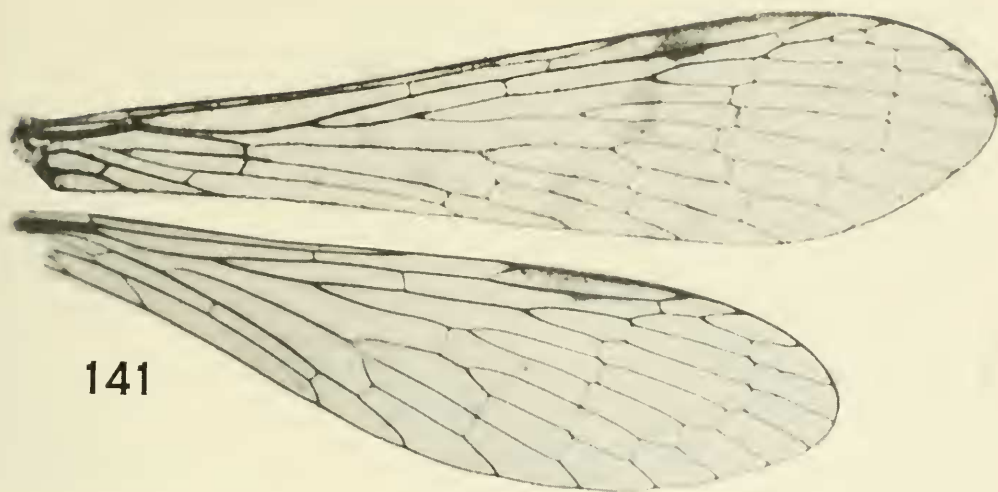
The probable relationships are mentioned under *N. borneensis*. The elongate notal organ (posterior process of abdominal tergum 3), the longer abdominal segments 7-8 and the shapes of the hypovalves and aedeagus of the male allow *spicata* to be easily differentiated from other Bornean species of *Neopanorpa* and from the Javanese and Sumatran species.

UNGROUPED SPECIES

Neopanorpa lieftincki, new species

Description based on 3 males, 1 female, pinned.

Head: Dorsum glossy brownish black; frons below antennal sockets dark brown; rostrum dark brown anteriorly, yellowish brown laterally; mouthparts dark brown, tips of palps blackish brown. Antennal scape brown, pedicel dark brown, flagellum dull brown at base, grading into dull dark brown, with 42 (holotype) to 43 flagellomeres.



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FIG. 141. *Neopanorpa lieftincki*, new species, right wings of female paratype.

Thorax: Pronotum brownish black, bearing 4 bristles on each side along anterior margin. Mesonotal and metanotal scuta mostly black, brown along posterolateral margins and dark brown near wing bases; scutella dark brown. Pleura and coxae dull yellowish brown, brown (two paratypes) or dark brown (female). Femora yellowish brown; tibiae and tarsi dark brown.

Wings (Fig. 141): Almost colorless and slightly iridescent, with faint smoky brown markings. Apical band reduced to small, faint spots, or almost absent. Pterostigmal band indistinct, slender, constricted or broken at mid-length, with distal branch present only as separate spot at posterior margin of wing. Marginal spot absent. Basal band represented by two faint spots. Hind wing clear except for faint, poorly defined pterostigma.

Abdomen of male: Terga 1-5 blackish brown to dark brown (one paratype); sterna 2-5 yellowish brown. Segment 6 blackish brown dorsally, dark brown ventrally. Segments 7-9 brown (7 reddish brown in one paratype), except hypovalves of sternum 9 dull yellowish brown and

dististyles dark brown apically. Posterior process of tergum 3 short, triangular, extending about one-third across tergum 4 (process deformed in holotype, bearing a projection laterally on left, Fig. 147). Hypovalves of sternum 9 dull yellowish brown, expanded in apical 2/3, mesal margins broadly overlapped, outer margins strongly infolded dorsally, folded edges subparallel in ventral aspect (Fig. 142). Ninth tergum yellowish brown, slightly constricted near apex and bearing long hairs at both sides of very slight emargination (Fig. 146). Cerci pale basally, dark brown apically. Basistyles brown, with two large, membranous pouches (probably pheromone sacs) anteroventrally between them (Figs. 142, 145); dististyles brown at base, dark brown apically, outer margins slightly concave in basal half (Fig. 142). Basal lobes of dististyles semicircular in ventral aspect, with crescentic ventromesal concavity; a few large pale hairs on ventral and distal surfaces (Fig. 145); a long seta projecting from dorsal surface of lobe and about 4 apically curved, smaller spines projecting from anterodorsal surface (Fig. 144). Dorsal, basal margins of

basal lobes clear, thin subacute blades. Aedeagus slightly sclerotized, reddish brown; ventral valves large, narrowing ventrally to broad, appressed blades, slightly divergent at apex, projecting well beyond much smaller, blackened dorsal valves (Fig. 148); lateral processes simple, concave posteromesally; dorsal parameres subrectangular with uneven dorsal margin (Fig. 148); ventral parameres absent.

Abdomen of female: Terga 1-6 black; sterna 2-5 sordid dark yellowish brown, sternum 6 dull brown. Segment 7 dark brown. Terga 8-10 brown, corresponding sterna light brown. Cerci dark brown. Subgenital plate mostly yellowish brown, brown laterally, with slightly notched apex and a whitish, hairless streak (about one-third length of plate) anterior to notch; bearing long setae along lateral margins and at each side of notch. Axial portion of genital plate ovoid, with stout, divergent anterior apodemes (Fig. 150); arms of plate broad, subtranslucent toward apex, twisted and yellowish brown basally.

Body length: Male, 14.3-19.1 mm (holotype 18.3 mm); female (allotype), 16.7 mm. *Length of fore wing:* Male, 13.2-14 mm (holotype 13.7 mm); female (allotype), 14 mm.

Holotype: Male, crater of Mt. Tanggamus, southwestern Lampongs, southern Sumatra (see map), 1900 m, 1 Jan. 1935, M. A. Lieftinck. Allotype, female and 2 male paratypes, same data as for holotype. Holotype, allotype and 1 ♂ paratype in the Rijksmuseum van Natuurlijke Historie, Leiden; 1 ♂ paratype in the Snow Entomological Museum, The University of Kansas.

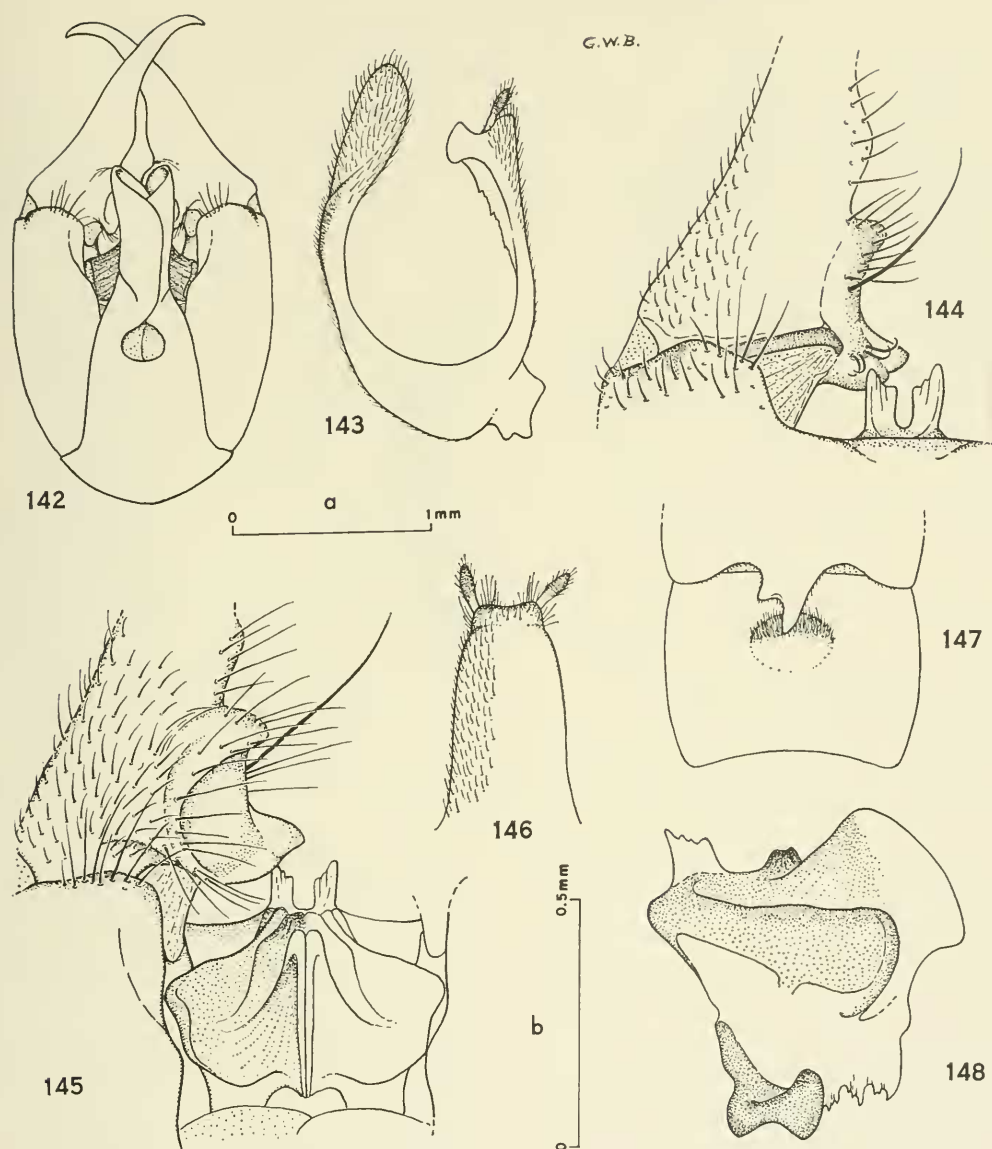
Lieftinck (1936) says this species was immediately recognized as undescribed because of its vivid grass-green color during life. The four specimens he found were in the ancient crater of Mt. Tanggamus, about 33 m below the summit (2100 m). The crater holds a well-protected marsh

with a luxuriant growth of *Rhododendron*. This species cannot be placed in any of the groups recognized above. It is close to the *muelleri* group on the basis of structure of aedeagus and the basal lobes of dististyles (except that it lacks the black dorsal spines). In the obscure, faint wing pattern, it looks identical with *diloba*. It differs from *diloba* by the shorter hypovalves and the way they are infolded. The genital bulb is also a little longer and more slender than those of *diloba* and *muelleri*, especially the dististyles. This species is named in honor of its discoverer, Dr. M. A. Lieftinck, in recognition of his great contributions to the knowledge of Indonesian Mecoptera.

COMPARISON BETWEEN *NEOPANORPA* AND *LEPTOPANORPA*

The genus *Leptopanorpa*, as mentioned earlier, occurs only in Indonesia, possibly in Java, only (there is a record of *L. charpentieri* from Sumatra, but it is doubtful), and contains 12 species. The records of *Leptopanorpa* from elsewhere than Java (*effusa*, Sikkim; *furcata*, Nepal; and *javanica*, in Hainan, Burma, etc.), pertain probably to *Neopanorpa* instead of to *Leptopanorpa* (Byers, 1965, 1971; Rust and Byers, 1976). Because of this confusion, *Neopanorpa* is compared with *Leptopanorpa* below.

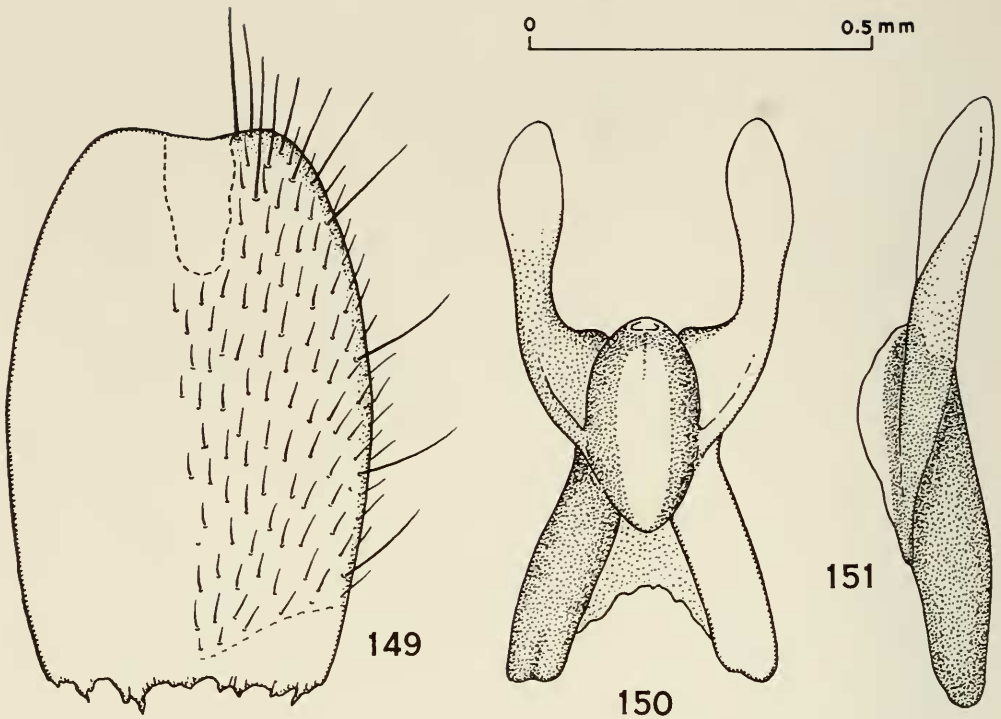
Neopanorpa and *Leptopanorpa* differ obviously in the body length of males. The body of males of *Neopanorpa* is about as long as the length of the wings or somewhat longer, but in *Leptopanorpa* it is usually much longer than the length of the wings (except *cingulata* and *javanica*). The different abdominal length is due mainly to the shape of abdominal segments 6-8. In *Neopanorpa*, these are robust and usually not elongate. In contrast, in *Leptopanorpa* they are ordinarily long and slen-



FIGS. 142-148. *Neopanorpa lieftincki*, new species, structural details of male. 142, genital bulb, ventral aspect; holotype. 143, ninth abdominal tergum and sternum, right lateral aspect; paratype. 144, base of right dististyle and dorsal parameres, dorsal aspect; paratype. 145, base of left dististyle and aedeagus, ventral aspect; paratype. 146, ninth abdominal tergum, dorsal aspect, most hairs omitted; paratype. 147, abdominal terga 3 and 4, dorsal aspect showing atypical (deformed) notal organ; holotype. 148, aedeagus, left lateral aspect; paratype. Scale a—FIGS. 142-143, 146-147; scale b—FIGS. 144-145, 148.

der (except in *cinglata*, *inconspicua*, *javanica* and *peterseni*). Wings of *Neopanorpa* are usually broad, whereas those of *Leptopanorpa* are slender and much narrowed basally, except in *javanica* (similar to *Neopanorpa*).

The shape of the genital bulb also differentiates these two genera. In *Neopanorpa*, it is broad, generally oval in ventral aspect, and without a stalk at the base of the 9th segment. In *Leptopanorpa*, it is slender, generally elliptical, and has



FIGS. 149-151. *Neopanorpa lieftincki*, new species, details of genitalia of female paratype. 149, subgenital plate, ventral aspect, hairs partially omitted. 150, genital plate, ventral aspect, only partly shaded. 151, genital plate, right lateral aspect.

either a fairly long, basal petiole (*ritsemae*, etc.) or a shorter one (*cingulata*, etc.).

In the males of *Neopanorpa*, the hypovalves are usually broad, overlapping mesally or distally. Those of the Indian species *N. hirsuta* and *N. chillcotti* are more slender, as in some species of *Leptopanorpa*. However, in some species of *Leptopanorpa*, the hypovalves are broader than those of most *Neopanorpa*, yet never overlapping distally. The ninth abdominal tergum most easily differentiates these two genera. In most male *Neopanorpa*, tergum 9 has a broadly rounded distal margin, but in some species it is shallowly emarginate (e.g., *muelleri*); and in most it has subapical, lateroventral processes curving around segment 10 toward the interior of the genital bulb. In *Leptopanorpa* the median distal margin of tergum 9 either protrudes caudad slightly (as

in *charpentieri*), or forms a distinct process (*ritsemae*, etc.). Terga of either genus have the lateroventral processes directed toward the interior of the bulb, as in most species of *Neopanorpa*.

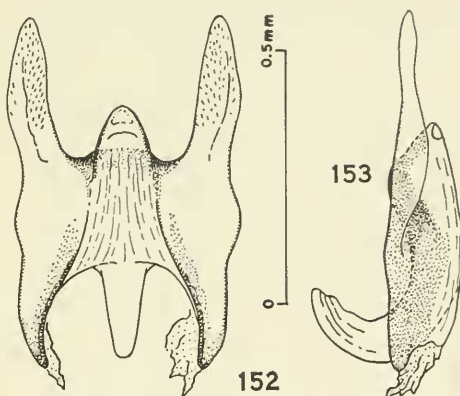
The aedeagus of *Neopanorpa* is usually located more or less equidistantly from sternum 9 and tergum 9, whereas that of *Leptopanorpa* is more ventral in position, so that the dorsal parameres are approximately halfway between the ninth tergum and sternum. The ventral parameres of the aedeagus of *Neopanorpa* may be either fairly long on mainland Chinese species and a few Indonesian species (*diloba* and *angustiapicula*), short on most Indo-Chinese species, or absent, as from most Indonesian species, whereas those of *Leptopanorpa* are always large and complicated. The dorsal parameres of *Neopanorpa* are small, shorter than the ventral valves and

almost invisible from dorsal view of the intact genital bulb, whereas those of *Leptopanorpa* are large, longer than the ventral valves and conspicuous in dorsal aspect. The ventral valves of *Neopanorpa* are the most conspicuous structures of the aedeagus in most species (except *diloba* and *angustiapicula*), whereas those of *Leptopanorpa* are much reduced and hardly visible. The lateral processes of *Neopanorpa* are broad and are evenly divided in *diloba* and *angustiapicula*, whereas those of *Leptopanorpa* are small.

One important difference is the shape of the basal lobes of the dististyles. They are rarely bilobed in *Neopanorpa* (except *diloba*) and most are concave anteroventrally (Indonesian and Indo-Chinese species), a few concave anteriorly (Indian species); but they are usually bilobed horizontally (in ventral aspect) in *Leptopanorpa*, except in *peterseni*, *cingulata*, *fili-cauda* and *inconspicua*, and are often concave dorsally.

The female of *Neopanorpa* is much like that of *Leptopanorpa* in general appearance, but the genitalia of the two genera are much different.

The subgenital plate in *Neopanorpa* is pale, apically, on most Indonesian species and some Indo-Chinese species. That of *Leptopanorpa* has a generally uniform color. The genital plates of *Neopanorpa* are much more flattened (except *umbo-nata*) than those of *Leptopanorpa* (except of *ritsemae*, *fili-cauda*). In *Neopanorpa*, the axial portion of the genital plate is sometimes forked anteriorly, whereas in *Leptopanorpa* it is either bluntly rounded or with broad basal plates, or protrudes ventrally, or bears a pair of small basal processes. The arms of the genital plate of *Neopanorpa* are usually broader than those of *Leptopanorpa* (except *robusta*, *cingulata* and *sarangana*, in which they are as broad as those of *Neopanorpa*). This difference



FIGS. 152-153. *Leptopanorpa charpentieri*, female syntype. 152, genital plate, ventral aspect. 153, genital plate, left lateral aspect.

is not easily noticed, unless specimens to compare are available.

As discussed above, under the heading of Zoogeography, we have examined the syntypes (1 ♂, 1 ♀) of *Leptopanorpa charpentieri* (Burmeister) and have compared the genital structures of the female with those of all Indonesian species. The genital plate (Figs. 152, 153) is clearly that of a *Leptopanorpa* and, in our opinion, the same as that described for *L. nematogaster* (MacLachlan) by Lieftinck (1936: 302, plate 14).

KEY TO GENERA OF PANORPIDAE

1. Vein 1A in front wing joining wing margin far beyond level of origin of radial sector; two cross-veins between 1A and 2A; in hind wing, 1A united with Cu₂ for only a short distance near wing base *Panorpa*
 Vein 1A short, extending little more than half distance from wing base to origin of radial sector in front wing; one cross-vein between 1A and 2A; in hind wing, 1A fused with Cu₂ nearly its entire length except for short distal portion resembling diagonal cross-vein 2

2. Abdomen of male long and slender, segment 7 twice or more (usually 2.5-3.5 times) length of segment 5; segment 3, excluding appendage, as long as or longer than its width; segment 9 tapering to slender, often elongate petiole at base; abdominal tergum 9 with small to conspicuous median caudal projection; axial portion of genital plate of female dorsally expanded, appearing thick when viewed from side *Leptopanorpa*

Abdomen of male shorter, extending only slightly beyond wing tips, with segment 7 not twice length of segment 5 and usually 1-1.5 times as long; segment 3, excluding appendage, wider than long; segment 9 narrowing abruptly to short, inconspicuous petiole at base (except *N. effusa* and *N. furcata* of Himalayas); tergum 9 without median caudal projection; axial portion of genital plate of female without dorsal expansion
..... *Neopanorpa*

GAZETTEER

Localities in the following gazetteer are arranged alphabetically. The number before each listed locality corresponds to a numbered locality on accompanying maps (Figs. 2-5). On the maps, localities are numbered from left (west) to right (east), except the maps of Java precede that of Sumatra. Data pertinent to each locality appear in the following sequence:

1. Name of locality as recorded on or translated from pin label.
2. Variant spellings of name, or synonymous names, in parentheses.
3. General region (W. J.—West Java; E. J.—East Java; C. J.—Central Java) in which locality is situated.
4. Geographic coordinates, if available, or reference to another locality that is well known.
5. Elevation where collection was made, if available.

6. Brief description of habitat, if available.

LOCALITIES

52. Airbangis, Sumatra; 0°12' N, 99°23' E; not below 1200 m; in the Padang Highland, not far from Fort de Kock.
55. Andalas, Tandj, Sumatra; 0°07' S, 100°41' E; no elevation recorded; a village.
45. Bajukidul (Baju-Kidul), Mt. Raung, E. J.; 8°12' S, 114°09' E; 500-800 m; estate at foot of Mt. Raung, west of Banjuwangi; on the eastern coast of Java.
50. Bandarbaru (Bandar-Baru), northeastern Sumatra; 3°16' N, 98°33' E; 950 m; a village.
43. Baung, Banten, E. J.; 8°01' S, 113°29' E; at some altitude above Malang; a forest reserve.
23. Mt. Bengbeng, E. Djampang, W. J.; 7°13' S, 107°20' E; 400 m.
31. Mt. Bésér, W. J.; 7°11' S, 109°39' E; 1300 m.
1. Bibidjilan, Distr. Banten, south coast, W. J.; 200 m.
46. Blawan, Idjen Plateau, E. J.; 7°59' S, 114°09' E; 950 m.
26. Bodjongkalong, Djampang, W. J.; 7°00' S, 107°42' E; 300 m.
49. Brastagi, northeastern Sumatra; 1400 m; a mountain resort at foot of Mt. Sibajak, some hours by car south of capital, Medan.
54. Bukittinggi—see Fort de Kock.
9. Mt. Bunder, Salak, W. J.; about 6°42' S, 106°44' E; 800 m.
62. Mt. Dempu, Air Njuruk, Sumatra; 5°07' S, 104°55' E; no elevation recorded.
13. Depok, W. J.; 6°24' S, 106°50' E; 50-100 m; a small nature reserve between Djakarta and Bogor.
44. Djanbangan, Tengger Mts., E. J.; 7°58' S, 113°37' E; 1800 m.
11. Djampangtengah, Mt. Malang, W. J.; 7°03' S, 106°48' E; no elevation recorded; a village.
41. Djunggo, Malang, E. J.; 7°48' S, 112°31' E; no elevation recorded.
54. Fort de Kock (Bukittingi), Sumatra; 0°19' S, 100°22' E; 920 m; a city.

20. Mt. Gedeh, Tapos, W. J.; 6°47' S, 106°59' E; 700-800 m and 1200-1700 m.
60. Giesting, Mt. Tanggamus, southwestern Lampongs, southern Sumatra; 5°25' S, 104°42' E; 450 m; an estate on slope of Mt. Tanggamus.
30. Mt. Guntur, Kamojang, W. J.; 7°08' S, 107°50' E; 1400 m.
- Jesselton (Kota Kinabalu), Sabah; 5°59' N, 116°04' E.
36. Kaliurang (Kali Urang), Djokjakarta (Djocja), C. J.; 7°36' S, 110°25' E; low country; a town near Djokjakarta.
29. Kamodjang, Preanger, Mt. Guntur, W. J.; 7°10' S, 107°48' E; 1400-1450 m; collection was made in crater, near Garut.
3. Mt. Karang, Bantam, W. J.; 6°03' S, 106°09' E; 800-1000 m.
47. Kendeng Mts., Idjen Plateau, E. J.; 8°00' S, 114°15' E; 2000 m (1200-1300 m, acc. to Lieftinck).
- Mt. Kinabalu (Kini Balu, Kina Balu, Kina Batu), Sabah (British North Borneo); 6°05' N, 116°30' E; collection at 3300 ft (1015 m).
24. Lembang, Preanger, W. J.; 6°49' S, 107°36' E; 900 m; a summer resort above Bandung.
53. Lubuksikaping (Lubuk-Sikaping), western Sumatra; 0°08' N, 100°10' E; 450 m; a town.
39. Mt. Madiun, E. J.; 7°37' S, 111°31' E; 1200 m.
7. Mt. Malang, Djambangan, W. J.; 6°28' S, 106°43' E; 800 m.
27. Mt. Manglajang, Preanger, W. J.; 6°52' S, 107°44' E; 1400 m.
37. Marcodjambangan, Mt. Muria, northern Java; about 6°36' S, 110°53' E; 1000 m; one of the elevations of the Mt. Muria Complex.
15. Mt. Megamendung, W. J.; 6°38' S, 106°55' E; 600 m; south-east of Bogor, in the hills near Mt. Gedeh.
56. Muarasako (Muara Sako), Sumatra; 2°07' S, 101°13' E; no elevation recorded.
42. Nongkodjadar (Nongkodjadar), Tenger Mts., E. J.; 7°54' S, 112°49' E; 1200 m; a summer resort.
33. Oengaran—see Mt. Ungaran.
48. Ongop-ongop, Idjen Plateau, E. J.; about 8°05' S, 114°15' E; 1850 m; a village.
19. Mt. Pangerango, W. J.; 6°46' S, 106°57' E; no elevation recorded.
14. Pantjar Mts., Mt. Gedeh, W. J.; 6°35' S, 106°54' E; 1500 m.
28. Pateungteung, W. J.; 7°09' S, 107°46' E; 1300 m; a town.
32. Patjet, Mt. Bésér, W. J.; 7°34' S, 109°50' E; 1300 m.
4. Preanger, W. J.; 7°12' S, 106°47' E; 1500 m; an upland area in W. J.
22. Radjamandala, W. J.; 6°50' S, 107°20' E; 335 m; a village.
16. Selabintana, Mt. Gedeh, W. J.; 6°52' S, 106°57' E; 1000 m; near Sukabumi.
34. Semarang, C. J.; 6°58' S, 110°25' E; no elevation recorded.
57. Serapai, Mt. Kurintji (Korinchi), Sumatra; about 1°42' S, 101°16' E; 1000-1400 m.
58. Subanajam (Suban Ajam), Sumatra; about 4°15' S, 103°00' E; 800-1000 m; in Bengkulen.
12. Sukabumi, W. J.; about 6°13' S, 106°46' E; no elevation recorded.
21. Sukanegara, Djampang, W. J.; 7°06' S, 107°07' E; 700-1000 m; in a damp forest.
40. Sumberbrantas (Sumber Brantas), Mt. Ardjuno-Mt. Andjasmoro, E. J.; about 7°45' S, 112°30' E; 1500-2400 m.
51. Tandjunggading, west coast of Sumatra; 3°18' N, 99°20' E; 1000 m; a village.
59. Mt. Tanggamus (crater), southwestern Lampongs, southern Sumatra; 5°25' S, 104°42' E; 1900 m; *Neopanorpa lieftincki* n. sp. was taken here, in the forest below summit of Mt. Tanggamus.
25. Mt. Tangkubanprahu (Tangkuban Prah), Preanger, W. J.; 6°44' S, 107°36' E; 1400 m.
35. Telomojo, Res. Kedu, C. J.; 7°22' S, 110°24' E; 1200 m.
- Tenompok, 48 km E of Jesselton, Sabah; approximately 6°00' N, 116°30' E; south foot of Mt. Kinabalu; elevation not recorded but probably near 2000 m.
18. Tjibodas, Mt. Gedeh, W. J.; 6°45' S, 107°01' E; 1550-1700 m.

2. Tjibunar Estate, Mt. Gedeh-Pangrango, W. J.; 6°50' S, 106°04' E; 1000 m; on west slope of Mt. Gedeh-Pangrango.
38. Tjilo, Muria Mts., C. J.; 6°40' S, 110°54' E; 800 m.
8. Tjiomas, Warungloa (Warung Loa), Mt. Salak, W. J.; 6°36' S, 106°45' E; 300-400 m; SE of Tjipeundeuj, Warungloa is a village at the foot of Mt. Salak, near Bogor.
5. Tjipeundeuj, Leuwiliang, W. J.; about 6°40' S, 106°29' E; 800-900 m; a village W of Bogor, in the hills near Mt. Gedeh.
17. Tjisarua, Mt. Pangerango-Gedeh, W. J.; 6°40' S, 106°59' E; 1000-1300 m.
10. Mt. Tjisuru, W. J.; about 7°24' S, 106°48' E; 500-600 m; in the middle of the Djampang District.
33. Mt. Ungaran, C. J.; 7°12' S, 110°20' E; 800-1200 m; where E. Jacobson collected many years.
61. Wai Lima, Lampongs, southern Sumatra; no elevation recorded; a coastal village in the Lampong District, extreme southern Sumatra.
60. Wai Tebu, Mt. Tanggamus, southern Sumatra; 300-500 m; a river near Giesting at foot of Mt. Tanggamus.
6. Wynkoops Bay, Pelabuhanratu, southwestern Java; 7°03' S, 106°27' E; no elevation recorded; in low country.

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